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1920.



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B.L. 8-inch Howitzers, Marks VI to VIII, on Travelling Carriages (Plate VIII).

B.L. 9.2-inch Howitzers, Marks I and II, on Siege Carriages (Plate VIII).

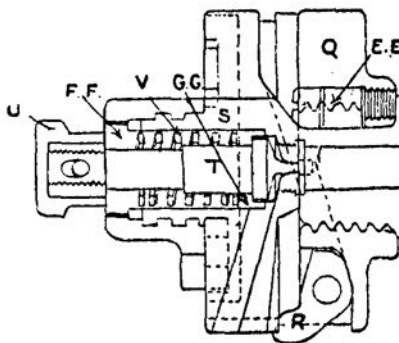
For "F.F.-Striker collar"

Read "F.F.-Rebound collar."

For "G.G.-Rebound collar"

Read "G.G.-Main spring collar."

The above-mentioned Plates should also be amended to show the position of reference "G.G." as per sketch below :—



Issued, January, 1921.

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OF THE
B.L. 9·2-INCH HOWITZERS,
MARKS I & II.

1920.



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NOTE.—This book is corrected up to February, 1920. Any alterations which may be suggested should be forwarded direct to the Chief Inspector of Armaments, Inspection Department, Royal Arsenal, Woolwich.

B.L. 9·2-INCH HOWITZER, MARK I.

NOTE.—The B.L. 9·2-inch *Mark I* howitzer can ONLY be mounted on the *Mark I* siege carriage and the *Mark II* howitzer on the *Mark II* siege carriage. The attention of all concerned is drawn to this non-changeability of Marks of howitzers and carriages, so as to obviate possible errors in issues and assembly.

HOWITZER.

Material	Nickel steel (wire construction.)
Weight, average—	Ton. cwt. qr. lb.
Of Howitzer without breech fittings...	2 16 1 20
Of breech fittings	0 4 1 14
Length, total (approximate)	133½-inches.
Bore—	
Calibre	9·2-inches.
Length (approximate)	121½-inches.
Chamber—	
Diameter	9·8-inches.
Length to base of projectile	8·1-inches.
Capacity	660-cubic inches.
Rifling—	
System	Polygroove, plain section.
Length (approximate)	110-inches.
Twist	Uniform, 1 turn in 15 calibres.
Number of grooves	56.
Firing mechanism	Vent T axial, or lock percussion, “P.H.” and box, slide, “V.”

HOWITZER BODY.

(Plate I.)

The howitzer consists of an “A” tube, muzzle stop ring, a series of layers of steel wire, jacket, breech bush and breech ring. Over the exterior of the “A” tube are wound a series of layers of steel wire extending from the breech end to the stop ring which is shrunk over the “A” tube at the muzzle. Over the exterior of the “A” tube, wire and muzzle stop ring, is shrunk the jacket, secured longitudinally by the breech bush which is screwed into the rear end of the jacket; the bush is also prepared for the reception of the breech screw. The breech ring is screwed and shrunk over the jacket at the rear.

The breech ring is prepared for the reception of the breech mechanism, and a lug is formed on the upper side for the attachment of the howitzer to the hydraulic buffer of the carriage.

Projections are formed on the under-side of the breech ring for connection to the transporting wagon and on the underside of the jacket near the muzzle for connecting the howitzer to the slipper of the carriage.

The exterior of the jacket is furnished with two longitudinal pro-

jections at the horizontal axis forming guides for the howitzer when in the cradle of the carriage.

The chamber is cylindrical, coned at the front end.

A plane for clinometer is prepared on the upper right side of the breech ring.

Axis lines are cut on the horizontal axis at the breech and muzzle ends. Fine horizontal and vertical axis lines are also cut on the breech and muzzle faces.

The actual weight of the howitzer is engraved on the top of the breech ring.

The nature, Mark, registered number, manufacturer's initials and year of manufacture are engraved on the upper portion of the breech face.

BREECH MECHANISM.

(*Plates III & IV.*)

The breech mechanism is so arranged that by partially revolving the breech mechanism lever the breech screw is unlocked and the screw with the obturating pad and discs withdrawn from the seating in the chamber, the breech mechanism can then be swung into the loading position by means of a handle on the rear face of the breech screw. After loading, the mechanism is swung against the breech of the howitzer and the front end of the breech screw inserted in the breech opening, the breech mechanism lever is then turned in the opposite direction as far as it will go, thus forcing the screw and the obturating pad and discs home, and turning the screw into the locked position.

BREECH CLOSING MECHANISM.

The breech is closed by a parallel screw having five portions of the screw thread removed longitudinally, each one-tenth of the circumference. The interior of the howitzer at the breech being prepared in a similar manner admits of the screw, when the raised portions are placed opposite the smooth surfaces in the howitzer, being forced home and locked by the tenth of a turn.

The breech screw is supported when withdrawn by a bronze carrier hinged to the right side of the breech ring. Upon the front of the carrier is a cylindrical projection forming a pivot for the breech screw which is secured thereon by a fixing screw so arranged as to admit of the breech screw being partially revolved and travelled in working the breech.

A steel spindle for actuating the breech screw is fitted to the carrier on the right side and is worked by the breech mechanism lever. The actuating spindle is furnished with a crank portion which engages a cam groove in the rear face of the breech screw in locking or unlocking, and with two worm teeth segments for slow and quick movement, respectively, which engage with corresponding recesses in the breech screw when inserting or withdrawing the screw and obturator into or from the seating in the chamber.

The breech screw is retained in the open position by means of a catch in the interior of the carrier on the lower side which engages a recess in the actuating spindle. The catch also serves to retain the

breech mechanism lever in the firing position when the breech is closed.

A handle is provided on the rear face of the breech screw for use in swinging the mechanism into the open or closed positions.

The carrier is retained in the loading position by a "latch."

FIRING MECHANISM WITH "VENT, T, AXIAL."

The firing mechanism is designed for firing with T-tubes.

It consists of a steel axial vent passing through the centre of the breech screw, and the cylindrical projection on the carrier, and is retained in the breech screw by means of a sleeve, spiral spring, collar and nut. The outer end of the vent bolt is furnished with a removable steel vent head and copper washer. The vent head is chambered to suit the T-tube and prepared with a bayonet joint for the reception of the head of the T-tube, the copper washer being adjusted to admit of the vent head being screwed home to the correct position as indicated by corresponding arrows on the bolt and vent head respectively. A spring is provided round the outer end of the vent for retaining the T-tube in position.

The T-tube is turned into the firing position, and withdrawn by hand.

NOTE.—Care must be taken to see that the breech screw is locked in the howitzer and that the indicating lines on the rear face of breech screw and breech end correspond before the T-tube is inserted in the vent.

The lever, (Plate XLVIII) for extracting and inserting the T-tube in the event of a missfire, is of steel. It is crooked at one end and furnished with a catch block and flat spring to grip the head of the T-tube. The other end of the lever is chisel-shaped.

FIRING MECHANISM WITH "LOCK PERCUSSION, 'P.H.' AND "BOX, SLIDE, 'V.'"

The firing mechanism with "P.H." percussion lock and "V" slide box is designed for percussion firing with "tube, percussion, S.A. cartridge," the removable vent head which is screwed in the rear end of the axial vent bolt having its outer end chambered to suit the tube and prepared on the exterior with a screw thread for the reception of the "V" slide box. The vent head is secured in position by a set screw, the copper washer being adjusted until the holes prepared in the vent bolt and vent head for the reception of the set screw are in alignment.

The "P.H." percussion lock and "V" slide box are the same as described on Page 15 herein for B.L. 9·2-inch Mark II howitzer.

OBTURATION.

Obturation is obtained by a mushroom-headed axial vent of steel passing through the centre of the breech screw with two pads (front and rear) with centre steel ring and a pair of metal discs. The inner face of the breech screw is flat and between it and the head of the vent the pads with centre ring and the discs are arranged. The pads are made of asbestos worked up with mutton suet or rape oil

to a proper consistency and enclosed in strong canvas covers †; they are reduced to shape and pressed in a hydraulic machine. The pads with centre ring are enclosed between two protecting discs.

The front and rear protecting discs are of tin, each having a steel ring round the outer circumference. The rear disc is also bushed with a ring of manganese bronze.

The obturation is of the slow coned type.

The discs are stamped with the words "Front" and "Rear" respectively and the pads have the words "Front" stencilled on the side which corresponds with the front disc, and "Rear" on that which corresponds with the rear disc in order that they may be correctly assembled on the vent.

If correctly assembled, the whole should fit together compactly.

Thin steel adjusting discs are provided for insertion behind the rear protecting disc when found necessary.

Action.—When the breech screw is travelled into the breech opening, the obturator enters the chamber with perfect ease; on turning the breech screw the pad is pressed home into the coned seating in the chamber by the travel of the screw. The bore is thus perfectly closed by a species of buffer in contact all round the circumference, while the mushroom-head of the axial vent receives the force of the gas on discharge. On firing the howitzer the pressure acts on the mushroom head of the vent and compresses the pads against the breech screw, causing them to expand laterally. From symmetry of form and position this expansion must be radial to the axis and equal in every direction, and is sufficient to prevent the escape of the gas. On the pressure being removed elasticity comes into play, and the pads and discs can be withdrawn from the coned seating so soon as the screw is unlocked.

Full instructions regarding the fitting, testing, adjusting and treatment of obturating pads and discs are contained in "Regulations for Magazines and Care of War Matériel."

TO REMOVE THE BREECH FITTINGS.

Before commencing to remove the fittings the breech screw and carrier must be swung into the loading position.

*Howitzers with "P.H." percussion Lock and "V" Slide Box
Firing Mechanism.*

Lock, Percussion, "P.H."—Remove the extractor axis screw from the "V" slide box and turn the actuating lever of the lock to the open position, then withdraw the lock and extractor lever from the slide box in an upward direction.

Box, Slide, "V."—Remove the securing screw and unscrew the slide box from the axial vent and withdraw to the rear.

Vent, Axial and Obturator.—Unscrew the nut from axial vent and withdraw the latter with obturator from the front end of breech screw, then remove spring and sleeve from the rear.

† Future manufacture of pads will be wire woven, in one piece without centre ring.

Howitzers with Axial T-vent Firing Mechanism.

Vent, T, Axial and Obturator.—Unscrew the nut from axial "T" vent and withdraw the latter with obturator from the front end of breech screw; then remove collar, spring and sleeve from the rear.

Howitzers with either of the above Firing Mechanisms.

Breech Screw.—Take out fixing screw from the body of breech screw, push catch retaining breech screw clear of the recess in breech screw, turn breech mechanism lever anti-clockwise one half a turn and when the lever is in a vertical position the breech screw can be removed from the front of the carrier.

Catch, Retaining, Breech Screw Open and Breech Mechanism Lever Closed.—Remove the retaining screw and withdraw the catch and spring.

Carrier.—Remove the hinge bolt and withdraw the carrier to the rear; this is the only way the carrier can be removed from the hinge joint.

TO ASSEMBLE BREECH MECHANISM.

Reverse the procedure outlined above.

CARE AND PRESERVATION OF HOWITZER AND FITTINGS.

(See also "Regulations for Magazines and Care of War Matériel.")

The breech fittings and also the projections on the exterior of the howitzer which form guides for the latter when sliding in the cradle of the carriage should be kept clean, oiled or greased and maintained in good working order. All working surfaces must be well lubricated, the fittings being taken off sometimes for this purpose.

The threads of the breech screw should be free from burrs; should the screw not work easily when the obturator has been detached, the defect may often be remedied by careful filing, but no portion of the thread should be cut away to remove a crack, &c.

The breech should be covered up when possible to prevent dust and grit getting into the interstices of the breech fittings, which might impede their easy working. A cover is provided for this purpose.

LIST OF LUBRICATORS IN BREECH MECHANISM.

Fitting to be Lubricated.	No. of Holes.	Position of Holes.
Actuating shaft	1	In boss on rear face of carrier.
Carrier hinge joint	1	On top of hinge bolt.
Breech screw	1	On top side of breech screw.

B.L. 9.2-INCH HOWITZER, MARK II.

HOWITZER.					
Material	...	...	...	...	Steel (wire construction).
Weight, average—					
Of howitzer without breech fittings...					4-tons 1-qr.
Of breech fittings	...	...	...	...	5-cwt. 1-qr.
Length, total (approximate)	...	...	...	...	170½-inches.
Bore—					
Calibre	...	...	...	...	9.2-inches.
Length	...	...	...	...	159.16-inches = 17.3-cals.
Capacity	...	...	...	...	11,085-cubic inches.
Chamber—					
Diameter	...	...	...	...	9.8-inches.
Length to base of projectile	...	...	...	...	34.035-inches.
Capacity	...	...	...	...	2,600-cubic inches.
Rifling—					
System	...	...	...	...	Polygroove, plain section.
Length (approximate)	...	...	...	...	121½-inches.
Twist	...	...	...	...	Uniform 1 turn in 25-calibres.
Number of grooves	...	...	...	...	56.
Firing mechanism	...	...	...	...	Vent T axial or lock, percussion, "P.H." and box slide "V."

HOWITZER BODY.

(Plate II.)

The howitzer consists of an "A" tube, inner "A" tube, muzzle stop ring, a series of layers of steel wire, jacket, breech bush and breech ring. The "A" tube is lined with an inner "A" tube extending from the seat of obturator and projecting slightly at the muzzle. Over the exterior of the "A" tube are wound a series of layers of steel wire extending from the breech end to the muzzle stop ring which is shrunk over the "A" tube at the muzzle. Over the exterior of the muzzle stop ring, wire and "A" tube, is shrunk the jacket, secured longitudinally by corresponding shoulders on the muzzle stop ring and "A" tube and the breech bush which is screwed into the rear end of the jacket. The bush is also prepared for the reception of the breech screw. The breech ring is screwed and shrunk over the jacket at the rear. Securing screws are provided in the breech face to prevent the breech ring and breech bush turning when in position.

The breech ring is provided on the right side with upper and lower lugs for the reception of the breech mechanism, the upper lug being removable; a lug is formed on the upper side for the attachment of the howitzer to the hydraulic buffer of the carriage.

Bronze bearing strips are provided on the under-side of the breech ring. Projections are formed on the under side of the breech ring for connection to the transporting wagon, and on the under side of the jacket for connecting the howitzer to the slipper of the carriage.

The exterior of the jacket is furnished with longitudinal projections at the horizontal axis forming guides for the howitzer when in the cradle of the carriage.

The chamber is cylindrical, coned at the front end.

A plane for clinometer is prepared on the right upper side of the breech ring.

Axis lines are cut on the upper side and on the horizontal axis at the breech and muzzle ends. Fine horizontal and vertical axis lines are also cut on the breech and muzzle faces.

The actual weight of the howitzer (without breech mechanism) is engraved on the top of the breech ring, and a line, denoting centre of gravity (without mechanism), is cut transversely on the upper side of the jacket and stamped "C. of G."

The nature, Mark, register number, manufacturer's initials and year of manufacture are engraved on the upper portion of the breech face.

BREECH MECHANISM.

(Plates V & VI.)

The breech mechanism is worked by means of a lever on the right side of the breech. On pulling the lever to the rear the breech screw is automatically unlocked and swung into the loading position. After loading, one thrust on the same lever inserts the breech screw and turns it into the locked position. When the T-tube firing mechanism is fitted a safety shutter is provided in the rear face of the carrier and prevents the insertion of a T-tube in the vent until the breech screw is securely locked and the breech mechanism lever quite home.

BREECH CLOSING MECHANISM.

The breech is closed by a parallel screw of the Welin type, which is divided circumferentially into 12 equal parts, four of which are plain and the remaining eight screw-threaded, thus giving a two-thirds bearing surface to the breech screw in the locked position. The screwed parts are of varying diameters, the breech opening of the howitzer being prepared in a corresponding manner. The interruptions in the howitzer are arranged to accommodate the segments of the screw of largest diameter; thus, when the screw is unlocked, these segments pass into the interruptions and the segments smaller in diameter unlock into the spaces left vacant by those of the larger diameter.

The interior of the screw is recessed to fit over a pintle on the front of the carrier and is bored through its centre for the reception of the axial vent.

The breech screw is supported when withdrawn by a bronze carrier hinged to the right side of the breech ring, the dead weight of the mechanism being taken on a ball-bearing in the upper carrier hinge lug on the breech ring. Upper and lower roller bearings are provided in the lugs of the hinge joint to facilitate working. Upon the front of the carrier is a pintle forming a pivot for the breech screw which is secured thereon by means of a retaining plate and an eccentric

actuating pin in the rear end of the breech screw, so arranged as to admit of the breech screw being revolved through one-twelfth of a circle on the pintle in locking and unlocking.

By depressing the eccentric pin against a spring, it can be rotated through 180°, the plate being thus drawn back flush with the hole in the breech screw, for assembling or dismantling.

This arrangement also permits of the carrier being withdrawn independently of the breech screw, should the latter become fast in the breech.

A recess for a crosshead is provided in the right side of the breech screw. The crosshead is actuated by means of a crank and breech mechanism lever in the carrier so as to revolve the screw in locking and unlocking. A roller with axis pin on the rear face of the breech screw and a cam on the breech end, are also provided, to give a turning movement to the breech screw in closing.

A control arc is provided in the hinge joint of the breech ring, over which the lower end of the breech mechanism lever rides and thus prevents the breech screw rotating as the mechanism is swung into the loading position. The arc is also used as a friction brake to control the swing out of the breech mechanism, when opening the breech while at angles of elevation, by slightly raising the lever and has a recess into which the lower end of the lever falls when it is slightly raised and thus retains the mechanism in the open position.

The breech mechanism lever is retained in the closed position by means of a catch in the lever, which engages a steel catch plate in the carrier.

FIRING MECHANISM.

The firing mechanism is designed for firing with T-tubes, or percussion S.A. cartridge, and is so arranged that the howitzer cannot be fired until the breech screw is locked and the breech mechanism lever home.

Firing Mechanism with "Vent, T, Axial."

The firing mechanism consists of a steel axial vent passing through the centre of the breech screw and the pintle on the carrier, being feathered to the latter to prevent it turning and is retained in the breech screw by means of a spiral spring with nut and an axial vent nut retaining pin, with keep pin. The outer end of the vent bolt is furnished with a removable steel vent head and copper washer. The vent head is chambered to suit the T-tube and prepared with a bayonet joint for the reception of the head of the T-tube, the copper washer being adjusted to admit of the vent head being screwed home to the correct position as indicated by corresponding arrows on the bolt and vent head respectively. A spring is provided round the outer end of the vent for retaining the T-tube in position.

The T-tube is turned into the firing position and withdrawn by hand.

A firing lanyard fair lead stud is provided in the upper rear side of the carrier.

The firing lanyard is pulled from the right side.

Firing Mechanism with "Lock, Percussion, 'P.H.' and Box, Slide, 'V.'"

(Plates VII and VIII.)

The firing mechanism with "P.H." percussion lock and "V" slide box is designed for percussion firing with "tube percussion S.A. cartridge," the outer end of the axial vent or No. 4 vent head in later type axial vent being chambered to suit the tube and prepared on the exterior with a screw thread for the reception of the "V" slide box.

The "box, slide, 'V.'" consists of a steel body screwed internally to suit the outer end of the axial vent and prepared for the reception of the "P.H." percussion lock. In the interior of the slide box is pivoted an extractor lever, the inner end of which engages the percussion tube in the vent and having a lug on the outer end, by means of which it is actuated in working the lock. A steel stop plate for the actuating lever catch of the lock is provided on the exterior and secured by two screwed rivets. The slide box is prevented from turning when in position by a securing screw.

The "lock, percussion, 'P.H.'" consists of a steel frame with firing hole bush and furnished with a striker, striker nut cap, main spring and rebound collars and main spring. The lock slides vertically in the slide box and is worked by means of an actuating lever with retaining catch plunger and spring, pivoted on the exterior of the frame. The striker is withdrawn and the main spring compressed by a steel wedge fork on the No. 33 firing lanyard, which engages the underside of the striker cap when placed in position and is released in firing by pulling the lanyard clear of the lock.

OBTURATION.

The obturator, which is of the steep coned type, is supported on the axial vent and is held tightly between the mushroom-shaped head of the latter and the front face of the breech screw by the spring and nut, vent axial.

The pad consists of asbestos worked up in mutton suet or rape oil to a proper consistency, enclosed in a strong canvas cover in the case of *Mark I* and wire-woven cover in the case of *Mark II*, and pressed into shape in a hydraulic machine.

It is enclosed between a front copper protecting disc, around the outer edge of which is a split steel ring and a rear inner and outer steel ring, the outer one being split. The disc is stamped with the word "front" and the pad has the word "front" stencilled on the side which corresponds with the front disc, and "rear" on that which corresponds with the inner and outer rear rings, in order that they may be correctly assembled on the vent.

If correctly assembled the whole should fit together compactly.

Thin steel adjusting discs are provided for insertion behind the rear steel rings and pad when found necessary.

Action.—When the breech screw is swung into the howitzer, the obturator enters the chamber with ease; on turning the breech screw the pad is pressed home into the coned seating of the howitzer by the travel of the screw. The bore is thus closed by the pad which is in contact with the bore all round its circumference, while the mushroom head of the axial vent receives the force of the gas on discharge. On firing the howitzer the pressure acts on the mushroom head of the vent and compresses the pad against the breech screw, thus causing it to expand. This expansion is radial to the axis and equal in every direction and is sufficient to prevent the escape of the gas. On the pressure being removed elasticity comes into play and the obturator can be withdrawn from the coned seating so soon as the screw is unlocked.

Full instructions regarding the fitting, testing, adjusting and treatment of obturating pads and discs are contained in "Regulations for Magazines and Care of War Matériel."

TO REMOVE THE BREECH FITTINGS.

Before removing the mechanism the breech must be opened and the breech mechanism swung into the loading position.

Howitzers with "P.H." Percussion Lock and "V" Slide Box Firing Mechanism.

Lock, percussion, "P.H."—Remove the extractor axis screw from the "V" slide box and turn the actuating lever of the lock to the open position, then withdraw the lock and extractor lever from the slide box in a downward direction.

Box, slide, "V"—Remove the securing screw and unscrew the slide box from the axial vent and withdraw to the rear.

Vent, axial, safety shutter and obturator.—Remove the keep pin from the "pin, retaining, axial vent nut and safety shutter" and withdraw the latter clear of the recesses in the vent axial nut and safety shutter. Unscrew the vent axial nut and remove the nut and safety shutter to the rear. Withdraw the axial vent and obturator from the front end of the breech screw.

Howitzers with Axial T-Vent Firing Mechanism.

Vent, T, Axial; Safety Shutter and Obturator.—Remove the keep pin from the "pin, retaining, axial vent nut and safety shutter" and withdraw the latter clear of the recesses in the vent axial nut and safety shutter. Unscrew the vent axial nut and remove the nut, T-tube retaining spring and safety shutter, to the rear. Withdraw the axial T-vent and obturator from the front end of the breech screw.

Howitzers with either of the above Firing Mechanisms.

Arc, Control and Cam, Rotating Breech Screw.—Remove the fixing screws and withdraw the control arc or rotating cam respectively (these fittings should not be taken off more often than necessary).

Breech screw.—Insert a screwdriver in slot of "pin, actuating, retaining plate," press in the pin and partially revolve it by means

of the screwdriver until the indicating arrow on the pin corresponds with the middle of the word "dismantle" on the breech screw, then withdraw the breech screw from the front of the carrier.

Roller.—Remove the keep pin and roller axis pin and withdraw the roller.

Breech mechanism lever.—Remove the keep pin from the lever and nut from the crank shaft and withdraw the breech mechanism lever.

Breech mechanism lever bearing, crank shaft and crosshead.—Remove the keep pin of the breech mechanism lever bearing securing bolt and withdraw the securing bolt. Withdraw the bearing and crank shaft from the carrier; at the same time, from inside the carrier, remove the crosshead from the inner end of the crank shaft.

Catch, breech mechanism lever.—Drive out the securing pin of the spring retaining block, slide the catch downwards in the breech mechanism lever and withdraw the catch, then remove the spring and retaining block.

Carrier.—Unscrew the clamping screw and adjusting screw of ball-bearing and withdraw ball-bearing securing cap and ball-bearing from upper lug. Unscrew the retaining screw from upper lug and withdraw the lug with upper roller bearing. Unscrew the clamping screw and retaining screw for lower roller bearing and withdraw lower roller bearing, then remove the carrier from lower lug of breech ring.

The under-mentioned fittings are not intended to be removed except on account of repair, as securing screws or stop rivets would have to be drilled or cut out to effect their removal :—

Pin, retaining, axial vent nut and safety shutter.

Plate, catch, breech mechanism lever.

Plate, retaining, breech screw.

TO ASSEMBLE THE BREECH FITTINGS.

The converse of the above takes place in re-assembling the fittings on the howitzer.

The mechanism will be adjusted with relation to the breech opening by means of the ball-bearing adjusting screw, which will be afterwards fixed in position by means of the clamping block and clamping screw in the carrier. The outer end of the clamping screw must be flush with the surface of the boss when screwed up.

CARE AND PRESERVATION OF HOWITZER AND FITTINGS (see also "Regulations for Magazines and Care of War Matériel").

The breech fittings and also the projections on the exterior of the howitzer which form guides for the latter when sliding in the cradle of the carriage should be kept clean, oiled or greased and maintained in good working order; all working surfaces must be well lubricated, the fittings being taken off sometimes for this purpose.

The threads of the breech screw should be free from burrs; should the screw not work easily when the obturator has been detached, the defect may often be remedied by careful filing, but no portion of the thread should be cut away to remove a crack, &c.

The breech should be kept covered up when possible, to prevent dust and grit getting into the interstices of the breech fittings which might impede their easy working. A cover is provided for this purpose.

LIST OF LUBRICATORS IN BREECH MECHANISM.

Fitting to be lubricated.	Lubricator.	Position of lubricator.
Bearing B.M. lever	1	On top side of carrier.
Safety shutter	1	On top left side of carrier.
Carrier hinge joint	1	On top of hinge pintle.
Breech screw and pintle of carrier	1	On top side of breech screw.

MISCELLANEOUS STORES.

Bit, vent, 18-inch.—This is of round steel furnished with a spiral bit at one end and hardened at the point; the opposite end is formed into a loop for convenience in handling. It is used for removing irregularities from the vent channel and for cleaning it.

Borer, vent axial, .303-in. chamber.—The borer is of steel shaped to suit the chamber for "Tube, percussion, S.A. cartridge" in the axial vent. The front end of the borer is serrated for removing obstructions of a hard nature from the tube chamber. The other end of the borer is provided with a cross handle.

The borer is used with "P.H." percussion lock mechanism.

Box, obturating pads and discs, Mark I. howitzer.—The box is of wood with metal bolt and fly nuts; to hold 3 pads and 3 sets of discs.

Box, obturator, Mark II howitzer.—The box is of wood with metal bolt and fly nuts to hold two obturators and adjusting discs.

Lanyard, firing, No. 23.—The No. 23 firing lanyard consists of a 6-foot length of $\frac{3}{8}$ -inch galvanized steel wire rope, with a steel hook blackened in oil attached to one end and a steel toggle to the opposite end by spliced and whipped loops.

Lanyard, firing, No. 33.—The No. 33 firing lanyard is of flexible steel wire rope, 6 feet long, with steel wedge fork and toggle. Two studs are provided in the side of the fork, which also serves as a tool for assembling and dismantling the striker spindle. This firing lanyard is for use with "P.H." percussion lock mechanism.

Press obturator.—Gauge, thickness, obturator.—Tommy, press, obturator.—The press and gauge are intended for use in reforming obturators which have become so distorted as to cause difficulty in placing them in position on the axial vent in the howitzer.

The press consists of a steel body, shaped internally to suit the contour of the obturator and fitted with a steel cover. The cover is secured by means of a steel bolt with disc spring washer and cross-handle. The bolt is provided with a square head, by means of which the press can be held in a vice while the crosshandle is revolved when compressing or releasing the obturator. A steel tommy is provided for use with the crosshandle in compressing the obturator. Recesses are formed round the periphery of the press so as to admit of the application of the gauge for testing the thickness of the obturator while under compression.

The gauge is of flat steel plate and is for use in testing the thickness of the obturator.

Rimer, vent axial, .303-inch chamber No. 2.—The No. 2 rimer is of bronze and steel, the bronze portion being shaped to suit the chamber for "Tube, percussion, S.A. cartridge," and having flats formed on it for removing residue from the chamber. The shank is of steel and furnished with a crosshandle. The No. 2 rimer is used with "P.H." percussion lock mechanism.

No. 1 rimer, which is generally similar to the No. 2 rimer described above, but has a double joint in the shank portion, can be used with P.H. percussion lock firing mechanism in lieu of No. 2.

Rimer, vent, T.—The rimer is of bronze with steel shank and crosshandle and is used for clearing the tube chamber of the axial T vent. This rimer is used with T-friction tube mechanism.

Wrenches, breech mechanism—

No. 103

" 104

" 105

" 165 } The wrenches are of steel and are for use in removing
" 166 } and replacing the nuts and screws of the breech
" 167 } mechanism of the howitzer.

" 169 For removing and replacing vent head in axial T vent.

No. 199.—The wrench is of steel, having at one end a spanner, which is not required for use with this equipment and provided at the other end with a bronze end piece with rivets for use when assembling and dismantling the "V" slide box. The wrench is for use with "P.H." percussion lock mechanism.

CARRIAGE, SIEGE, B.L., 9.2-INCH HOWITZER, MARK I.

(Plates IX to XI and XIV to XVIII.)

The carriage is constructed to allow of the howitzer being fired at any angle varying from 15 degrees elevation to 55 degrees elevation, the angle for loading being 3 degrees depression. The bed admits of the howitzer being fired and traversed through an arc of 60 degrees (30 degrees right and left). The howitzer recoils axially in a cradle,

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B 2

the latter being fitted with a hydraulic buffer which limits the recoil to about 40 inches at 15 degrees elevation and 23 inches at 55 degrees elevation and a hydro-pneumatic recuperator to return the howitzer to the firing position. Special mechanism is fitted which automatically regulates the run out according to the elevation.

By the attachment of carriages and limbers the carriage can be transported in two loads—the body with cradle forming one load and the bed the other.

The carriage consists of the following principal parts:—Bed, body, cradle with hydraulic buffer and recuperator, pump, elevating, traversing and loading gears.

BED.

(*Plates XIV and XV.*)

The bed is rectangular in form and consists principally of two side girders (box section), a transom, pivot block and brake gear.

At the front end the pivot block (in 2 parts) is fitted for the reception of the front of the carriage body. The under part is formed with a central stem or pivot and includes the lower roller path. The top part, to which the carriage body is secured, forms the upper roller path. A roller ring with rollers is interposed between the upper and lower roller paths so as to facilitate traverse. The transom, which is fitted at the rear end extends beyond the length of the side girders and contains a bracket for engaging with its transporting limber. To this transom and immediately above it, a roller path with traversing rack is attached. The ends of this attachment, which extend beyond the width of the bed, are hinged in order that they may be swung back to admit of the wheels transporting the carriage body passing when mounting the body on the bed. A bearing plate for securing the rear end of the carriage body is supported on rollers and affords an easy traverse along the roller path. Guides are riveted to the outside of the girders for the pegs securing the bed in the pit. Three holding-down clip plates are fitted to the pivot block and one to the bearing plate at the rear which prevent the carriage body from lifting when the howitzer is fired. A degree scale plate and pointer is attached to the left side of the pivot block for indicating the angle of traverse. The vertical pintles are riveted at the firing front end to engage with the transporting carriage.

At the travelling rear of the bed a draught link is provided for the attachment of the draught connector of the next load and brake gear is fitted, consisting of two brake arms, two brake screws with handwheels and two brake blocks.

The brake arms are hinged one on each side in front of the hind wheels, each arm being provided with a shoe for the brake block; either brake arm can be applied independently of the other by means of its brake screw.

The brake screws are each pivoted at one end (near the handwheel) in a bronze bearing attached to the travelling rear of the bed, the other end of the screw is connected to the brake arm. The brakes are applied by handwheels.

The brake blocks are of cast iron ; they are secured in the shoes by keep pins.

A V-shaped thrust bar is attached to the firing rear of the bed and acts as a fulcrum for a lifting strut on the transporting wagon.

BODY.

(Plates XVI to XVIII.)

The body is constructed of steel, and consists of two side brackets strengthened by channel stays and connected by front and rear transoms. The front transom is prepared for the pivot block of the bed, the rear transom being provided with bearings for the spindle of the traversing rack pinion. Bearings, fitted with capsquares, are riveted to the top of each side to take the cradle trunnions. Two ramps are secured on the sloping portion of the side brackets towards the rear ; these ramps serve as guides for the rollers of the transporting wagon when shifting the howitzer from the wagon into the cradle. Brackets are fitted to the rear and blocks with clips to the front for the reception of the axletrees of the transporting limbers. Brackets for the necessary gears are also provided and fitted on the left side. There are hinged platforms on each side for giving access to the various working parts and a platform at the rear for loading. A degree scale strip and pointer is fitted on the right side for indicating the angle of elevation of the howitzer. Clips for carrying the " case, memo. of examination " are fitted on the left side.

CRADLE.

(Plates XVI to XVIII.)

The cradle is a cylindrical chamber for the howitzer, having trunnions to pivot it to the carriage body and two openings underneath which form bearings for securing the cylinder of the recuperator rigidly in position ; to the underside of these bearings the elevating arc is also attached. On top, extending from front to rear, a slide is formed for the travel of the hydraulic buffer cylinder. The chamber has longitudinal grooves cut to fit a projection on each side of the howitzer which act as guides and prevent any turning movement of the howitzer in the cradle ; an extension of the cradle at the front end forms a guide for the crosshead to which the muzzle end of the howitzer is secured. A bracket is fixed on top at the front end for connecting the piston rod of the hydraulic buffer. There are two lugs at the rear for housing the buffer and one under the front to take the securing stay, all of which must be connected up for travelling.

CUT OFF GEAR.

A toothed arc is secured to the right trunnion which, through spur and mitre gearing imparts motion to a bar, which transmits through spur gearing a slight rotary movement to the piston rod, thus automatically reducing the recoil as the elevation increases.

A tell-tale is fitted to the 4th motion spur-wheel segment and consists of a small pointer which shows the rotation of the buffer piston at any length of recoil.

A beating face, consisting of a wood block with a steel supporting bracket, is secured to the recuperator crosshead to obviate the possibility of the glands, &c., being damaged by the recoil.

HYDRAULIC BUFFER.

(Plate XXI.)

The hydraulic buffer consists of a cylinder, piston with rod, rotating valve, stuffing box and gland.

The cylinder is secured to the howitzer and moves with it, the piston rod remaining stationary; it has two longitudinal grooves cut spirally in its bore, which engage with projections on the rotating valve; on its underside longitudinal projections are formed to fit the slide on top of the cradle; it is prolonged beyond the main portion at the rear end, this prolongation being smaller in dimensions constitutes the control chamber and is formed externally to engage with the breech ring of the howitzer to which it is secured. The front end of the cylinder is closed by the stuffing box and gland which contains the packings. The packing in the buffer piston rod stuffing box consists of one leather† ring of L-section, and one asbestos ring.

A recoil indicator is secured to the cylinder and consists of a gun metal bracket, with pointer and spring, which is made, by the movement of the cylinder on recoil, to travel over graduations on the cradle; these graduations show the normal length of recoil at each 5 degrees elevation of the howitzer.

On top is bolted a tank, with filling and air plugs. The tank is connected to the rear end of the cylinder by a pipe. The front end of the cylinder is provided with an air-hole closed by a plug and leather washer and also an air-release valve to release any air which may accumulate during firing. The air-release valve consists of a steel valve fitted in a hollow plug, the inner end of which forms a seating for the valve. On the upper end of the valve spindle is screwed and pinned a nut and between the nut and a shoulder in the plug is a spiral spring to keep the valve closed. On the right side of the tank are two brackets to support a rod, the rear end of which is provided with a handle and the front with a cam, the latter being arranged so that when the handle is raised it presses down on the valve and opens it against the pressure of its spring and allows the air to escape. On releasing the handle the spring forces the valve back into its seating.

A securing band of steel is formed to fit round the buffer tank and secured to the buffer cylinder by two screws.

The piston with rod and control plunger is in one forging of steel the plunger being at the rear end, and the piston between the rod and the plunger. Two ports are cut in the piston for the passage of the liquid.

The rotating valve, which is of bronze, has similar ports to those of the piston; it has also two projections which engage with the grooves of the cylinder. The valve occupies a position close to the piston on the piston rod. The recoil is controlled by the flow of the liquid through the ports in the piston and valve.

† In future the L-leather packing ring will be of rub-metal or dermatine.

Two air holes and one filling hole closed by plugs are provided. The quantity of buffer oil required is about $7\frac{1}{2}$ gallons.

HYDRO-PNEUMATIC RECUPERATOR.†

(Plate XXI.)

The hydro-pneumatic recuperator consists of a cylinder, ram, floating piston with rod, stuffing box and gland.

The cylinder is held in bearings on the cradle below the howitzer, and remains stationary, the ram, being secured to a crosshead attached to the muzzle of the howitzer, moves with it. The front end is closed by a stuffing box and gland which contains the packings and the rear end is provided with an air hole. Stuffing boxes of recuperator ram and floating piston rod, each contain two leather rings of U-sections and one asbestos ring.

The ram has an air hole and a filling hole at the front end which are closed by plugs.

The floating piston and rod is in one forging of steel; the piston is provided with two U-leather and one L-leather packing ring to fit the bore of the cylinder, the packings being secured in position by two bronze rings. The packing on the floating piston head consists of three leather rings (two U-section and one L-section) held in position by suitable bronze rings, which are secured by a ring nut with set screw; the two U-leathers maintain the liquid pressure, the L-leather the air pressure in cylinder.

The quantity of buffer oil required is about 3 gallons.

ACTION OF BUFFER AND RECUPERATOR.

On recoil, the howitzer simultaneously draws the cylinder of the buffer and the ram of the recuperator with it to the rear; the liquid in the buffer cylinder in passing from the front of the piston to the rear is forced past the ports of the piston and rotating valve. The ports in the latter become gradually less by the turning movement imparted to the valve through its travel along the grooves of the cylinder and so diminishes the space for the flow of the liquid, thus terminating the recoil; meanwhile, the ram of the recuperator, being drawn into its cylinder, increases the liquid pressure which, acting on the floating piston, compresses the air; when the energy of recoil is expended by the buffer, the compressed air in the recuperator returns the howitzer to the firing position.

PUMP, AIR, TWO-STAGE, VERTICAL, No. 1.

(Plates XXIII and XXIV.)

The air pump is situated on the inside of the right bracket of the carriage body and will develop a pressure of 600-lbs. per square inch.

It is of the vertical two-stage compressor type, with "high" and "low" pressure cylinders, one above the other. The lower cylinder (low-pressure) is provided with a suction valve with a drip feed oil lubricator, and is connected to the top of the high-pressure cylinder

† In future the U-leather and L-leather packing rings for the H.P. Recuperator will be of Rub-metal or dermatine.

by a short pipe, at each end of which is an intermediate delivery valve. The high-pressure cylinder is also connected to the delivery nozzle through a delivery valve. Working in the cylinders is a double ram, packed with compound steel rings. The ram is provided with a spindle, on each end of which is a link. The lower end of these fit around eccentrics on a spindle in the pump casing. On one end of this spindle is a flywheel, the other end being connected through a train of spur gear to winch handles on a cross-shaft supported in bearings in the carriage body.

The cylinders are enclosed in a M.B. jacket, which forms a water jacket for cooling purposes. This jacket is provided with filling and drain screws, and must only be filled when the pump is in use.

A dust cover is provided for the pump.

The two intermediate delivery valves and the delivery valve are interchangeable.

The pipe above the delivery valve is fitted with a screwed stop valve to enable the pipe to be cut off from the pump in order to get a good speed of revolutions with the latter before the back pressure from pipe comes on it.

Action.—On turning the winch handles the spur gear actuates the spindle and eccentrics, which forces the ram up and down by means of the links.

As the ram lifts, air is drawn into the low-pressure cylinder through the suction valve. As the ram drops, the suction valve is closed by its spring and the internal pressure and the air passes through the short pipe to the high-pressure cylinder, lifting the two intermediate valves in its passage there. The valves are again closed by their springs as soon as the movement of the air ceases.

As the ram again lifts, the air, which has already been compressed from the large (low-pressure) cylinder to the small (high-pressure) cylinder, is driven out through the delivery valve to the delivery nozzle of the pump, thence through the pipe to the air cylinder of the recuperator.

An occasional drop of oil passes through the suction valve with the air into the low-pressure cylinder to lubricate the various working parts. To actuate the automatic lubricator when working, raise the lever at the lubricator to a vertical position. This lifts the needle valve off its seat; then turn the milled collar till the correct number of drops per minute (2 to 4) is seen to pass through the glass tube. When ceasing to work the pump, lower the lever.

ELEVATING GEAR.

The elevating gear is actuated by a handwheel on the left side of the carriage body, on which side the sight also is fixed. The handwheel transmits motion through bevel and worm wheel gearing (enclosed in brackets) to an arc pinion shaft and thence to the arc attached beneath the cradle. To bring the howitzer to the loading position without moving the sight, a quick motion gear actuated by a handwheel is fitted to the right side of the carriage body; this gear is brought into operation by means of a foot lever, which at the same

time releases a catch of the elevating gear and renders it inoperative. The howitzer can then be brought into the loading position without altering the sight line.

TRAVERSING GEAR.

Traversing is effected by means of a handwheel and pinion gearing, on the left side of the carriage body, motion being transmitted to a vertical rack pinion which works in the rack at the rear end of the bed.

LOADING GEAR.

The loading gear is on the left side of the carriage body at the rear ; it consists of a loading arm with tray, actuated by a winch handle. The arm, which is hinged to a bracket, is provided with a toothed arc for gearing with the driving pinion ; a ratchet wheel and pawl retains the tray (with projectile) in the required position.

HOLDFAST, B.L. 9.2-INCH MARK I SIEGE CARRIAGE, MARK II.

(Plate XXV.)

The holdfast consists of 5 beams (1 cross, 2 diagonal and 2 longitudinal) with fittings, skid cross beam with fittings, 2 tie-rods (1 long and 1 short), 8 pegs securing bed, 2 pegs securing diagonal beams, 6 holding-down bolts, 15 planks and earth box.

The *cross beam* is of steel, and is provided with two pairs of brackets, in which the rear ends of the longitudinal beams are secured by pins, thus preventing the latter from moving on firing.

The *diagonal beams* are of wood, each fitted at one end with steel plates, to form a hinge and are fastened together by a hinge bolt with nut and keep pin. They are secured to the longitudinal beams by two steel pegs, which fit into the centre socket for pegs and also to the cross beam by means of bolts, which are passed through the diagonal beams and cross beam. In addition, the beams have angle plates bolted to the top to retain them in position.

The *longitudinal beams* are of steel, and each is provided with three picket sockets on the outside, whilst near the front ends brackets are provided for the stanchions of the earth box. They are connected at their front ends by the short tie-rod, while their rear ends, fit into brackets on the cross beams, which ensures them being kept in the correct position for assembling the carriage. The two longitudinal beams are braced diagonally by the long tie-rod. Two screwed M.B. sockets are provided in each longitudinal beam to receive the holding-down bolts of the carriage bed and a stud is provided on each beam towards the rear to enter sockets on the bed, to form guides on assembling. A thrust bracket is bolted on top of each beam, against which butts the front transom of the bed to prevent the holding-down bolts from being sheared.

The *skid cross beam* is of wood, and is provided with a steel angle

plate and washer plates, secured by bolts and nuts, for engaging with the cross beam.

Ten of the planks are placed under the longitudinal beams at the earth-box end and at right angles to them. The remaining five planks are placed behind the earth box on top of the longitudinal beams so that sandbags may be placed thereon if considered necessary.

Pickets are provided for securing the holdfast to the ground. They are of channel steel; their lower ends are wedge-shaped, for driving into the ground, while the upper ends are plugged with wood to receive the blow from the pile driver. The upper end of the plug is tapped to take the pile driver guide rod.

The *earth box* is a collapsible steel box holding about 11 tons of earth. It consists of two side pieces joined by front, rear and bottom plates. Stanchions are provided to fit into the sockets on the side beams. For travelling the earth box is taken to pieces and the parts packed on top of the carriage bed.

TRANSPORTING VEHICLES.†

WAGON, TRANSPORTING, B.L. 9·2-INCH HOWITZER, MARK I.

(*Plates XII, XIII, XIX and XX.*)

The wagon consists of a fore and hind carriage mounted on wheels, and is arranged for horse or engine draught, the latter being the normal method.

The fore carriage is mounted on an axletree and two 1st Class "B" No. 108† wheels, each arm being provided with a dust excluder and linch pin. It is a framework of steel consisting of futchels formed for the reception of the axletree and draught pole, with a splinter bar at the front which is fitted with draught hooks for two swingle-trees, and joints for the attachment of an engine draught connector; there is a pivot on top over the centre of the axletree for connecting the hind carriage.

The hind carriage is supported at the rear on an axletree and two 1st Class "B" No. 108† wheels, each arm being provided with a dust excluder and linch pin. It consists of a steel rectangular bed prepared on its upper surface to receive the howitzer. At its travelling front the howitzer is secured by means of two pawls which are brought into contact with the projections on the underside of the breech ring; the muzzle end is supported by two bronze brackets engaging with the projections on the howitzer which is further secured by a wire rope and draw nuts. Under the rear a steel framework is fitted for the attachment of the brake arms. It is also fitted with a draught link in rear for attachment of the draught connector of the next load.

A winch gear, actuated by winch handles, is fitted for the purpose of shifting the howitzer into, or from, the carriage cradle. It consists of an endless chain which by means of sprocket wheels, imparts motion to a larger endless chain to which the howitzer is connected.

† In future transporting vehicles will be issued without fittings for horse draught.

† Future supplies will be No. 10, Mark IV.

Two rods, one on each side, are attached to a crossbar for connecting the rear of the wagon to the carriage body when mounting or dismounting the howitzer. Two guide rollers are fitted at the rear and a V-shaped strut is hinged underneath. This latter on being acted upon by the screw gear, and engaging with the thrust bar at the end of the bed, raises the rear of the wagon into position. In order to bring the guide rollers into the guides on the carriage body when ramping the rear of the wagon, a screw gear actuated by winch handles is provided; any side adjustment required is obtained by means of a handwheel on the left side near the axletree, which, through bevel wheel gearing, traverses the end along the top of the axletree bed.

The brake gear is generally similar to that described for the carriage bed, page 20.

The fittings for horse draught consists of a draught pole (special pattern), a No. 4 supporting bar and two No. 13 swingletrees.

A 5½-inch roller scotch and drag shoe No. 14, connected by chains, are attached for use when travelling.

CARRIAGE, TRANSPORTING, BODY AND CRADLE, MARK I.

(Plates XVI to XX.)

The carriage consists of an axletree, two sides, a crossbar, brake fittings, and two 1st Class "B" No. 108† wheels.

The axletree is of steel, having its arms cranked and fitted with dust excluders, linch pins and adjusting collars; it is secured in position by the blocks and pivot on the breast of the carriage body; these fittings allow of an oscillation of the limber which compensates for any unevenness of ground. The sides are of tubular steel with sockets for connecting them to the axletree and crossbar, which latter is fitted with a crank lever at each end for the brake shoe and block and brake screw nut.

Brake fittings are provided on each side and may be applied independently of each other. They consist of brake screws, hand wheels, brake nuts and bands for connecting the screws to the axletree.

Two seats attached to the crossbar are provided for the men applying the brakes when travelling.†

The roller scotch and drag shoe are the same as those used with the wagon, transporting howitzer.

LIMBER, TRANSPORTING, BODY AND CRADLE, MARK I.

(Plates XVI and XVIII to XX.)

The limber consists mainly of an axletree bed, two axle arms, centre plate, draught frame, two radial bars and two 1st Class "B" No. 108† wheels.

The axletree bed is of steel formed with a joint at each end in which the axle arms are connected by hinge pins; it has two vertical

† Future supplies will be No. 10, Mark IV.

† The fitting of seats to the crossbar, for use by brake numbers, will be discontinued in all future equipments.

holes for raising screws. The axle arms are 1st Class "B" and are each formed with a crank and fitted with a dust excluder, linch pin and adjusting collar. A plate formed for the reception of the draught frame is bolted to the centre of the axletree.

The draught frame, which is built up of steel plate and angle, is triangular in shape and is hinged to the centre plate by a vertical tube; it is formed to take the draught pole and fitted with draught hooks for two swingletrees and joints for an engine draught connector. The radial bars are each connected at one end to a central pin, the other end being coupled to the crank of the axle arm; by this means the movement of the arms is controlled within the requisite angle of lock.

The fittings for horse draught are the same as those used with the transporting wagon.

CARRIAGE, TRANSPORTING BED, MARK I.

(Plates XIV, XV, XIX and XX.)

The carriage consists of an axletree and a pair of wheels.

The axletree is of steel; it is attached to the travelling rear of the bed, and has two vertical holes for raising screws; it is fitted with dust excluders, linch pins and adjusting collars and carries two 1st Class "B" No. 108† wheels. A roller scotch and drag shoe are provided, similar to those used with the wagon, transporting howitzer.

LIMBER, TRANSPORTING, CARRIAGE BED, MARK I.

(Plates XIV, XV, XIX and XX.)

The limber, which is connected to the front of the bed, is generally similar to the limber used for transporting the carriage body and cradle, with the exception that it has only one hole in the axletree bed for a raising screw.

The fittings for horse draught and wheels are the same as those used with the wagon, transporting howitzer.

CARE AND PRESERVATION OF MARK I CARRIAGES, &c.

(See also "Regulations for Magazines and Care of War Matériel.")

HYDRAULIC BUFFER.

The buffer cylinder must be filled with the correct quantity of liquid, viz., 6½-gallons and correctly attached to the howitzer, split keep pin being at all times inserted.

When adjusting the gland of the buffer, great care must be taken that the gland is not screwed up too tightly, otherwise it will bind the piston-rod and damage the recoil cut-off gear.

CAUTION :—

When adjusting the gland the howitzer should be alternately elevated and depressed by means of the quick-loading gear and the gland tightened cautiously until the tightness is just felt on the hand-wheel of the quick-loading gear.

† Future supplies will be No. 10, Mark IV.

Should the stuffing-box still leak, the gland should be removed and supplementary packing inserted.

If this fails to remedy the leak the old packing should be replaced by new.

Exposed part of piston rod should be periodically cleaned and coated with mineral jelly.

Before firing, the pin housing buffer at the rear end should be withdrawn, or damage may ensue.

To fill the cylinder.—Lay the howitzer horizontal, remove air and filling plugs in tanks and air plug in buffer. Pour in oil until it overflows at air hole of buffer; replace plug. Continue filling till oil overflows at air hole of tank; replace plugs.

Quantity of buffer oil required: about $7\frac{1}{2}$ -gallons.

RECUPERATOR.

When the floating piston is at zero, the quantity of liquid in the recuperator should be approximately 3-gallons; if leakage has occurred the floating piston will have moved out; the amount of movement must not, however, exceed 10-inches, which corresponds to a loss of a gallon of liquid, as shown on index scale on gunmetal cover over floating piston rod.

Before firing, ascertain air pressure in recuperator by means of the pressure gauge provided; if pressure is less than 320-lbs. per square inch, connect up copper pipe to air pump connection and recuperator, and pump up pressure to 475-lbs. per square inch.

The ram of recuperator should be cleaned and oiled before firing, and all glands overhauled.

Moderate tightening of glands should be sufficient to prevent leakage, but, if not, both leathers† and asbestos packing of stuffing boxes should be renewed.

Great care should be taken when assembling recuperator components that the edge of U-leathers† on piston head are not, under any circumstances, damaged when inserting floating piston in recuperator cylinder.

When not in use, the ram should be coated with mineral jelly, and covered with the canvas cover provided.

INSTRUCTIONS FOR CHARGING THE RECUPERATOR.

To Fill with Liquid and Air.

First secure the howitzer to the cradle, then elevate howitzer a few degrees and push floating piston right back. Remove filling and air hole plugs and, using the funnel provided, pour in liquid at the former till it overflows at the latter. Replace plugs, connect up pressure gauge and air pump, then pump in air till gauge registers 500-lbs. per square inch, unscrew the filling hole plug *one turn* and allow liquid to escape until tell-tale mark on rod coincides with the zero mark on index scale. Tighten filling hole plug and adjust pressure to 475-lbs. per square inch.

During severe weather, buffers and air recuperators will be protected as much as possible from the cold by covering them with sand-

† See note on page 23.

bags, sacking or straw, &c., and, when possible, by keeping the gun pits warm by means of braziers or stoves.

If this is done buffer oil should be efficient at temperatures down to 0° Fah.

CRADLE.

Before the howitzer is inserted in, or withdrawn from, the cradle, the securing link in front of cradle should be secured by the joint pin. Care should be taken, before insertion of the howitzer, to see that all traces of grit, &c., are removed from the howitzer guide grooves; the oil channels in these grooves particularly must be thoroughly cleaned out and, before inserting the howitzer, guides should be well lubricated.

The buffer cylinder guide faces on top of cradle must be cleaned and lubricated before firing; also, when dismantling, these guide faces are to be protected from rust by mineral jelly.

SIGHT, ROCKING BAR.

The rocking bar sight should be kept perfectly clean and free from grit, all working parts well oiled and, when not in use, lightly coated with mineral jelly and covered with the canvas cover provided.

Great care should be exercised at all times and particularly during cleaning operations, that spirit levels are not damaged or alignment disturbed.

ELEVATING GEAR.

When Mounting is assembled and before firing, the teeth of the elevating arc should be cleaned and lubricated, screws of oil holes of elevating worm and quick loading gear, also gear cases, should be removed and gearing well oiled; care always being taken to replace oil hole screws in order to exclude grit, &c.

When the quick motion gear is used and its loading position obtained, care should be taken that the catch-pin is in its proper position in the worm wheel.

When equipment is travelling, all working parts should be coated with mineral jelly to prevent rusting.

TRAVERSING GEAR.

When assembling the Mounting it is essential that, before central locking bolt of roller cage is withdrawn, the roller path on each side of cage should be thoroughly cleaned; then release locking bolt and shift roller cage over on one of the cleaned portions and clean the centre, lightly oiling the roller path and rollers.

Before engaging traversing pinion with rack, lubricate shaft bearings and all working parts, also ascertain that the mechanism operating the pinion is quite free.

When the carriage body has been dismantled for travelling, lightly coat roller path with mineral jelly to prevent rusting.

BRAKE GEAR.

It is essential that all brake gears of the three vehicles are kept in an efficient state; clotted oil and grit should never be allowed to collect on any of the working parts. All screws and pins should be kept well lubricated.

When about to haul howitzer into cradle from the transporting wagon, care should be taken that brake gear of howitzer wagon is in the housed position, otherwise damage to the handwheels may result.

RAISING SCREWS, PINS AND RATCHETS.

Before raising screws are used they should be cleaned and oiled; periodically, the nut should be run by hand the full length of the thread to prove that there are no tight places.

No dirt or clotted oil should be allowed to collect in the ratchet teeth; the pawl at all times should be kept in an efficient working condition.

When screws, pins and ratchets are not in use it is advisable to coat with mineral jelly as a rust preventative.

EARTH BOX.

The pins of all earth box connections are perfectly free normally and the use of a hammer should never be necessary; if pins cannot be inserted into the holes the cause is that the parts are not in alignment, and should be adjusted to suit.

When assembling and dismounting, pins, threads and holes for pins should be coated with mineral jelly.

PUMPS, AIR, VERTICAL, TWO-STAGE, No. 1.

(Plates XXIII and XXIV.)

Brief Instructions for Dismantling and Examination.

(i) *To dismantle and examine the valves.*—The second stage valves are placed vertically in the top cover. The first stage valves are placed horizontally at the bottom of pump. Access to these can be obtained by removing their caps (19) and plug (20).

NOTE.—*The first stage delivery and the second stage suction and delivery valves, together with their seats, plugs and caps, are interchangeable.*

(ii) *To examine the main bearings in the pedestal.*—Remove key (33) of the flywheel; take off flywheel; remove split pins and collars from the gudgeon pin (10) and take out eccentric rod (6); draw the eccentrics off the feather keys, remove feather keys from shaft and draw latter out of the bearing.

(iii) *To withdraw piston for examination.*—Remove locating stud (32); draw gudgeon pin (10); unscrew the four nuts on bottom flange of casing; the top part of pump can then be removed and the piston drawn out endways.

TO FIT NEW PACKING RINGS TO THE HIGH-PRESSURE PISTON IN HORIZONTAL OR VERTICAL PUMPS.

Place the piston carefully into a vice, using lead clamps to protect it. Remove the nut from the end on the high-pressure piston, draw off old rings and fit new ones.

In replacing, carefully make the low-pressure cover joint with brown paper soaked in boiled linseed oil.

TO REASSEMBLE PARTS OF PUMP.

The parts are replaced in the reverse order to that described above. The following data is a guide to locating faults :—

If no pressure is obtainable the fault may be due to one of the following causes :—

External Faults.

- (1) Probably suction cover not screwed back, release valve open, or meshes of wire gauze choked.
- (2) Pipe or adapter joints, cylinder cover, or valve caps leaking.

Internal Faults.

- (1) The L.P. inlet or L.P. delivery valves faulty, or valve seat joint defective.
- (2) Packing rings of L.P. or H.P. piston defective, or cylinders scored.
- (3) Air leak into water belt—due to faulty joint.

If pump is not working satisfactorily (with suction cover open), *i.e.*, pressure rising slowly, the defect may be due to any of the above causes. Should the fault occur at high pressure it will be more probably due to defective H.P. delivery valve, H.P. packing, or scored H.P. cylinder.

Before charging Recuperator it is advisable to test the pump system as follows :—

- (1) Close air charging valve on Recuperator.
- (2) Work pump slowly till gauge registers 500 or 600 lbs. per square inch.
- (3) If the system is in good working order the gauge hand should now be stationary or only "creeping" back very slowly—the latter being permissible.

Should the hand fall quickly, the system should be examined for external faults; if unable to locate the fault, it may be tested by smearing black wheel grease over joints, when air bubbles will be observable where there is a leak.

NOTE.—Great care should be exercised in using the gauge. When taking or releasing the pressure, the valve should be opened gently in order to prevent damage to gauge.

AIR COMPRESSORS AND AIR PUMPS.

GENERAL INSTRUCTIONS FOR CARE AND PRESERVATION IN THE FIELD.

(1) When not in use they must be kept carefully covered to protect them from dust, &c. Where boxes or covers are provided, the pump must be returned to its box or its cover replaced immediately the operation of charging is completed and great care must be taken to keep it in its box, or its cover on, when not in use.

(2) When assembling the machine, care must be taken to see that all parts are clean and free from grit.

(3) In some cases securing pins have feathers formed on them and when inserting the pins, care must be taken to see that the feathers are in line with the feather-ways.

(4) Lubricators must be filled with oil and carefully adjusted to feed at the correct rate.

(5) Grease cups are provided for the working parts ; these must be kept filled with semi-solid grease.

(6) All gearing, shaft bearings and driving chains must be kept well lubricated and free from dirt and grit.

(7) When charging a system it is better to continue until the desired pressure is reached, changing men if fatigued, without a stop. It is usually advisable to change men about every 3 minutes. Should a stop be unavoidable, the pump will be started much more easily if the recuperator valve on the mounting is closed and the relieving valve on the delivery pipe opened. As soon as the compressor is started the relieving valve must be reclosed and the recuperator valve reopened. *N.B.—If the recuperator valve is opened before pumping commences, the air will escape ; on the other hand, if it is not opened when pumping commences the connecting pipe would burst. In starting, therefore, give a couple of turns slowly, and immediately open recuperator valve.* When the operation is complete care must be taken to close the recuperator or reservoir valve securely and to tighten up the suction cover of the compressor to prevent admission of dirt. Sight-feed lubricators must also be turned off.

When using lever worked pumps it is most essential that a full stroke *i.e.*, from stop to stop, should always be made, otherwise full results cannot be obtained.

(8) Before starting work, an external examination should be made to see that the machine is clean and serviceable. See that the sight-feed lubricator is set to give 8 drips per minute, that the suction cover is screwed back 3 or 4 turns, and Stauffer lubricator tightened up. Where machines are provided with a water cooling jacket, great care must be taken that the jacket is filled with cold water before starting to work the pump and that it is kept filled while being used ; this is of the greatest importance to prevent overheating.

(9) Should there be any falling off in the working pressure, the valves should be examined to see if they are clean ; if gritty, the valves and springs should be removed and cleaned. If necessary, valves should be lightly ground to seats and coated with clean thin oil before

being replaced. If this does not improve the efficiency of the pump, the piston should be removed and the piston rings examined and tried in the cylinders. If the spring of these rings has been destroyed, the rings must be exchanged. Spare valves, rings and washers should be maintained as authorised by Mob. Store tables.

(10) To maintain these machines in good working order the pump should be worked *daily*; half a dozen strokes will suffice for this purpose.

(11) If a machine is in an exposed position during frosty weather, and allowed to stand for any length of time, the jacket should be emptied by drawing off the water through the drain hole provided for the purpose; if this is not done the cylinder may be fractured by frost. Care must be taken to refill the jacket with water before starting to work the pump again.

(12) When compressors are fitted into stands (or housings) with hand wheels and driving chains, the latter can be tightened by removing one or more of the washers which are placed underneath the compressor. By this means the compressor can be lowered about $\frac{3}{16}$ ths of an inch to take up any slack in the chain due to wear or stretching.

(13) In all correspondence relating to a machine its number should be quoted; and where spare parts are required the code words or numbers should be given.

SIGHTING, MARK I EQUIPMENT.

The carriage is fitted on the left side with a rocking bar sight. It is also provided with a No. 7 dial sight.

SIGHT, ROCKING BAR.

(Plate XXVI.)

The principal parts of the rocking bar sight are as follows :—

Bracket, oscillating.

Bracket, range.

Carrier, rocking bar and No. 7 dial sight.

Bar, rocking.

The oscillating bracket with adjusting screw and milled head and a cross level† is hinged to a supporting bracket which is attached to the bracket on the cradle. The oscillating bracket is also furnished with worm gear and handwheel and a scale plate with range dial ring graduated on the face and periphery from 0 to 55 degrees reading to 5 minutes. A reader to facilitate reading the scale is provided on the bracket. In future manufacture the range dial ring will be graduated in whole degrees only and the reader will be provided with a minute vernier scale, reading from 0 to 60 minutes in multiples of 5 minutes for the purpose of applying odd minutes of elevation.

Consequent on this modification the “ring, range dial” “ring, clamping, range dial” and “reader, range dial” will each be known as *Mark II*.

Pivoted in the oscillating bracket and actuated by the worm gear

† In future the cross-level carrier will be secured to a supporting bracket attached to the body of the range bracket instead of being carried on the oscillating bracket.

and handwheel is a range bracket which supports the carrier of the rocking bar and No. 7 dial sight. A cam actuated by a pinion and rack on the range bracket and a flat spring on the carrier, are provided for automatically adjusting the sight for the angle of drift for each elevation.

The rocking bar and No. 7 dial sight carrier is pivoted horizontally to the range bracket and is furnished with a longitudinal level. It is provided at the rear with a crosshead and deflection scale plate graduated for deflection of 5 degrees right and left. A traversing screw with deflection nut in two parts, with spring to obviate back lash, is provided in the crosshead and furnished with left and right deflection drums marked to read minutes in intervals of 5. The letters R. and L. are engraved against each numbered graduation on the deflection scale plate and micrometer drums to denote right and left respectively. The traversing screw is actuated by means of a milled head on the right side. A bracket prepared for the reception of the No. 7 dial sight carrier No. 4 is riveted to the rocking bar carrier.

The rocking bar consists of a steel arm with an acorn-pointed foresight and notched leaf for hind sight. It is pivoted horizontally on the carrier and provided at the rear end with a loop which engages the stud on the deflection nut in the crosshead of the carrier. Bearings with caps prepared for the reception of the No. 4 sighting telescope† or "Apparatus, illuminating, sights, No. 1," are provided on the left upper side of the rocking bar.

Mark IA.—The *Mark IA* sight differs from the *Mark I* in that the drift rack in the oscillating bracket is not provided with end plates, cover plates and carrier cover plates.

Mark II.—The *Mark II* sight differs from the *Mark I* in that it is set at a permanent angle of 5 degrees to the left and a permanent right deflection of 45 minutes to compensate for drift, the automatic gear being omitted.

SIGHT, DIAL, No. 7.

(Plates XXVII and XXVIII.)

The No. 7 dial sight is employed for both direct and indirect laying. The upper part of the sight can be revolved through a complete circle independently of the eye-piece, thereby allowing the layer to see objects in any direction without moving the position of his eye. Owing to the height of the sight the layer can lay on objects directly behind him, the line of sight being above his head. A coned seating in the sight rests on a coned projection on the dial sight carrier, and the sight is held down to the carrier by means of a spring washer in the latter and a nut on the lower end of the sight. The nut is castellated, and its position can be adjusted so that the sight has no movement in the carrier. A projection on the sight fitting into a recess on the carrier prevents the sight revolving.

Mark III.—The optical arrangements are so designed that an object viewed through the sight is always seen erect. They consist of—

F.—*The upper prism*, which is mounted in the upper portion of

† Telescope, sighting, No. 4, will not be issued with these equipments in future.

the sight. Its face can be turned in any direction with reference to the eye-piece K; the angle between the two being indicated on the dial plate A by means of a reader on the bracket N.

G.—The centre prism, which by means of bevel gearing is made to revolve at half the speed of the upper prism F. This arrangement ensures the object layed on, always appearing erect.

H.—A double reflecting roof prism.

J.—The object glass.

K.—The eye-piece, with two eye-lenses.

M.—A glass diaphragm, upon which are engraved vertical and horizontal lines with gaps near their centres; a radium dot is placed just below the optical centre on the vertical graticule, and is for use at night.

A glass window in the eye-piece allows the lines to be illuminated at night.

The magnification of the system is 4 diameters, and the field of view is 10 degrees. There are no arrangements for focussing the sight.

The principal mechanical parts are the following :—

B.—*The supporting pillar*, in which are suitably mounted the eye-piece K fitted with a dermatine eye-guard, the lower prism H and the object glass J. The “plug, supporting pillar” V is screwed into its lower end, and on it is a castellated nut, which is prevented from unscrewing by a split pin. Near the upper end of the supporting pillar is a coned seating W, which fits accurately on to a coned bearing in the carrier. The projection X which fits into a slot in the carrier prevents the sight revolving.

C.—*The worm wheel bracket* is firmly secured to the supporting pillar B. In it is mounted the slow motion traversing gear, which consists principally of a worm spindle S, the worm on which engages with the worm wheel D. On either end of the spindle is mounted a milled head and an adjustable minute drum. The drums are graduated in opposite directions in divisions of 10 minutes. Right angles being denoted by white lines on a black background and left angles by black lines on a brass background. For future manufacture the distinctive marking will be omitted, the graduations being filled in with black wax on a bright metal background. *Right* angles being indicated by the letter “R” and *left* angles by the letter “L.” The drums can be adjusted by loosening the caps inside the milled heads with a special wrench, and turning them independently of the milled heads. The readers for the drums are on the worm wheel bracket. Each turn of the worm spindle moves the upper part of the sight through 5 degrees. The worm spindle is mounted in an eccentric, which when turned by raising a lever near the left drum, throws the worm out of gear with the worm wheel. This enables the upper part of the sight to be revolved rapidly. The rear surface and 4 screws are for the attachment of the upper bracket of the deflection scale of the carrier.

D.—*The worm wheel* has teeth, which engage with the worm spindle S, cut on its lower portion. It extends upwards and is firmly secured to the upper prism holder E and the dial plate A by screws, &c.

Y.—*The centre prism holder* fits accurately in the supporting pillar B. To it is attached the prism mount P, in which the centre prism G is firmly held.

The prism holder is free to revolve, and is forced to do so at half the speed of the upper prism holder E by means of 3 bevel wheels. The axis of the vertical bevel wheel Z is formed on a projection from the prism holder. This wheel engages with the lower bevel wheel Z¹, which is fixed to the supporting pillar, and also with the upper bevel wheel Z², which is fixed to the upper part of the sight. When the upper part of the sight is revolved the axis of the centre bevel wheel, and consequently the central prism, are forced to revolve at half the speed of the upper part of the sight.

E.—*The upper prism holder*, as previously mentioned, is rigidly attached to the dial plate and worm wheel. In it are suitably mounted the upper prism and a glass window. A diaphragm is hinged to the case of the upper prism holder, by means of which the focus and parallax at short distance can be corrected without any appreciable loss of light. The diaphragm, which is fitted with a shutter, is only for use at short distances of approximately 20 yards or under. A spring is provided which retains the diaphragm and shutter in position when closed. In the centre of the diaphragm is a hole, .25-inch diameter, and in the shutter one of .125-inch diameter. If the object to be viewed is only a few feet away the shutter is to be used and the object viewed through the small hole. When the dial sight is used at a distance of more than 20 yards the diaphragm is to be lowered from the front of the window.

To enable the line of sight through the upper prism to be elevated or depressed, a small toothed arc is attached to the mount of the prism. The teeth of this arc engage with a worm spindle R. At the top of this spindle are mounted a milled head and an adjustable drum engraved with a zero mark. The reader is engraved on the prism holder; 17 degrees elevation or depression can be given.

The letters "E" and "D" are engraved against each numbered graduation to denote "Elevation" and "Depression" respectively.

A cross head with open sights (or view finder) is mounted on the right side of the upper prism holder. Its movement is regulated by that of the upper prism, but as the latter has a reflecting surface the former has to move twice as quickly. This is arranged for by a toothed wheel on the prism mount gearing with a toothed wheel, having only half the number of teeth, on the pivot of the crosshead with open sights.

Engraved on the under portion of the crosshead is a zero mark indicated by an arrow on the upper prism holder.

A.—*The dial plate*, as previously mentioned, is firmly fixed to the worm wheel and upper prism holder. It is cast with two lug pieces on it to prevent any play between the dial plate and the case upper prism holder. Two scales, each reading from 0 to 180 in single degrees, are engraved round the dial plate. Right angles being denoted by white lines on a black background and left angles by black lines on a brass background. For future manufacture the distinctive marking

will be omitted, the graduations being filled in with black wax on a bright metal background, *Right* graduations being indicated by the letter "R" and *Left* by the letter "L." The scales are read by a reader on the reader bracket N. This reader can be adjusted by loosening two screws in its rear surface and moving it to one side.

The *Mark II* differs from the *Mark III* as follows :—

- (1) The dial plate is not cast with two lug pieces on it.
- (2) The slope of the dial plate is steeper, which causes the reader plate to be slightly lower.
- (3) The boss on the top of the dial plate is slightly smaller in diameter, necessitating a smaller clamping collar and lead lining.
- (4) The vertical scale graduations on the upper prism holder crosshead and the micrometer head, excepting the zero and index marks, are omitted.

Mark I.—The *Mark I* sight differs from the *Mark II* in the following particulars :—

One of the milled heads on the worm spindle is smaller.

A vertical scale, with graduations to 15° elevation and depression, is fixed to the upper prism holder and the micrometer scale drum is graduated in intervals of 10 minutes.

Certain internal parts are of steel instead of bronze.

CASE, No. 7 DIAL SIGHT, No. 1.

A stout leather case with internal cork fittings and quick release strap is provided.

It is suitable for either mark of sight, except that the fittings which press against the milled heads of the traversing gear must be reduced in thickness when it is used for sights with the longer pattern milled heads.

Care must be taken when removing the sight from its case that no strain is put on the dial plate.

CARRIER, No. 7 DIAL SIGHT, No. 4.

(Plate XXVI.)

The No. 4 carrier consists of a steel bar which can be clamped into a fitting on the rocking bar carrier. The upper portion is shaped to take the dial sight. It is also fitted with arrangement for giving deflection up to 10 degrees right or left. This consists of an upper and lower bracket.† The upper bracket is connected to the dial sight by means of four screws and a feather; fitted through it is a worm with a minute micrometer head at each end, readers for which are fitted on the bracket. Along one face is fixed the deflection degree scale. The lower bracket which is fixed to the back of the dial sight has worm teeth cut on it into which the worm gears. There is also a reader for the deflection degree scale attached to it. The scale plate and micrometer drums are filled in with black wax, on a bright metal background and against each numbered graduation, the letters "R" or "L" are engraved to signify "Right" or "Left" respectively.

† In future manufacture of carriers the deflection brackets will be omitted.

CARE AND PRESERVATION OF SIGHTS.

(See also "Regulations for Magazines and Care of War Matériel.")

SIGHT, DIAL, No. 7.

The dial sight when issued is in correct adjustment, watertight and with all the cells and joints secured with fixing screws.

It is very unlikely that the interior will be required to be cleaned and the dial sight must on no account be taken to pieces, except by persons in possession of a certificate from the Ordnance College stating that they are qualified to do so.

The body of the dial sight must be cleaned with a soft clean rag and a little oil, which must be rubbed off afterwards, care being taken that the glass is not touched.

The exterior of the eye-lens and window should be cleaned with chamois leather, specially kept for the purpose and only by a competent person, great care being taken that no oil or grease is allowed to touch the glasses. Fingers, when apparently clean and dry, may leave marks on the lens which will impair the definition of the telescope.

Owing to the construction of the carrier, the deflection arrangement should be occasionally tested for backlash by laying on a well-defined object and traversing the sight from right to left alternately by means of the deflection screw until the vertical crossline is aligned. If the deflection scale does not read the same in both instances, the difference of reading indicates the backlash.

Backlash may be due to the small coned portion of the carrier which is removed when inserting the sight in its carrier having become strained or not fitting properly.

To correct this, the removable portion of the coned surface of the carrier may perhaps be made to fit more perfectly by manipulating its fixing screws. If this fails the coned surface of the removable portion should be slightly reduced with fine emery paper or a dead smooth file.

When not in use the dial sight must be kept in its leather case.

INSTRUCTIONS FOR TESTING AND ADJUSTING SIGHTS.

(1) *Levelling Tests.*

(a) The *cross level* should be in the centre of its run when the top of No. 7 dial sight carrier is level transversely.

Test.—Place a clinometer set at zero across the top of the dial sight carrier and bring the bubble of the clinometer in the centre of its run by the cross levelling gear. The bubble of the cross level should then be central; if not, the cross level should be adjusted by an Artificer.

(b) The *longitudinal level* should be in the centre of its run with the howitzer laid horizontal, sight gear on stops and range dial at zero.

Test.—Place a clinometer set at zero on top of the clinometer plane of howitzer and bring the bubble of clinometer to the centre of its run by working the elevating gear. The bubble of the longitudinal level should now be in the centre of its run; if not, the longitudinal level should be adjusted by an Artificer.

Note.—Before carrying out the tests as above the clinometer must be tested for index error.

(2) *Alignment Tests.*

(a) Before carrying out the alignment tests the mounting should be levelled transversely, or if this cannot be conveniently done the base line of target if used must be set parallel to slope of bedplate.

Test.—Construct a target testing sight as in Plate XXIX. Set the target up at a distance of 50 yards from howitzer, place crosswires at the muzzle, lay through axial vent and bore of howitzer on point "B" of target. Level the sight transversely and set the sight gear, deflection gear, also dial plate and micrometer head upper prism holder of the No. 7 dial sight at zero.

The line of sight through the open sight and dial sight should now fall on the points O and D respectively, both for elevation and line. If not, adjust as follows :—

(b) *Elevation :—*

Open Sight.—Should the open sight not be on O, slacken the clamping screw below the foresight and screw the latter up or down as required and re-tighten clamping screw.

Dial Sight.—The horizontal line in the dial sight should be lineable with the horizontal line on the target. If it is not, manipulate the micrometer head until correct position is obtained.

Loosen clamping nut of the drum head and while still maintaining the correct position of milled head, revolve the ring until the zero marks coincide, tighten clamping nut, exercising great care that correct position is maintained.

(c) *Direction :—*

Open sight.—Remove the keep pins and slacken the nuts of the pivot of the sight bar and cotter securing eccentric bush at front end of sight carrier. Release cotter and by means of a spanner turn the eccentric bush until the foresight is on its point O, then reclamp.

Dial Sight.—Bring the dial sight on to its point D by the deflection gear on the carrier. Slacken the clamping nuts of graduated drums and the screws of the reader of degree scale; set the drums and reader to zero, taking care not to turn the milled heads and reclamp.

Note.—If a distant point is available it should be used in preference to the target.

With the bore laid on a point at least 1,000 yards from howitzer, the telescope, open sight and dial sight should be adjusted on the same point, both for elevation and direction.

CARRIAGE, SIEGE, B.L., 9.2-INCH HOWITZER, MARK II.

This carriage is designed to take the (17.3 calibre) *Mark II* howitzer and admits of it being fired up to 50 degrees elevation.

In action "firing beams" are sunk into the ground, forming a platform to which is bolted a bed. The latter carries a roller path and turntable to which is bolted the carriage body, which in turn supports the cradle and howitzer. The latter is allowed axial recoil under the control of a hydraulic buffer, being returned to the firing position by an air recuperator.

An earth box is bolted across the front part of the firing beams to prevent the front of the carriage lifting on firing.

In travelling the equipment is divided into 3 loads :—

- (1) Howitzer.
- (2) Carriage bed.
- (3) Carriage body and cradle.

The howitzer is moved on a "wagon, transporting," which performs the dual function of travelling and mounting the howitzer.

The other two loads are carried on "carriages, transporting."

The loads may be moved "*en train*," or, as is normally done, each load separate.

The firing beams are transported in a G.S. wagon.

The principal parts of the carriage are :—

Bed, with pivot plate, roller ring and turntable.

Carriage body.

Traversing gear.

Cradle with hydraulic buffer, recoil control gear, air recuperator and pump.

Elevating gear.

Trunnion roller bearings.

Loading gear.

Sighting gear.

The transporting vehicles are :—

Wagon, transporting, B.L., 9·2-inch howitzer, Mark II.

Carriages and limbers, transporting body and cradle and bed, 9·2-inch howitzer, Mark II.

BED.

The bed consists of two steel side girders connected front and rear by transoms.

The front transom forms the lower part of the pivot block and has a hardened steel ring to form the lower roller path. It has an opening in the centre which is screw-threaded to receive a pivot plug. It is flanged externally to form a clip ring under which engages the holding-down clips on the upper portion of the pivot block.

On the left side is a socket to receive the catch retaining upper portion and on the same side is the graduated arc of the traversing indicator.

The rear transom is extended beyond the side pieces and tapered for clearance of the limber transporting in locking. Across the top is riveted a traversing bracket with a rack on its front face. On top of the bracket is secured a hard steel roller path above which runs a steel roller cage. Each end of the bracket is hinged and can be folded back for clearance in mounting.

The roller cage is provided to support the rear end of the carriage body and reduce the friction in traversing. Four bolt holes are provided to receive securing bolts.

The cage consists of a bracket fitted with six steel axles, on which run coned steel rollers. In travelling, the top part is covered by a

dust excluder. A holding-down clip is bolted to the rear face and engages under a flange on the traversing bracket.

Two loops are provided on the holding-down clip for attaching the socket supporting the strut used in mounting the howitzer. The cage is secured to the traversing bracket in travelling, by a locking pin. The bed is prepared for the reception of the holding-down bolts which secure it to the firing beams, sockets also being provided for the anti-shearing pins. The side girders of the bed dip in the centre to prevent fouling of the breech of the howitzer when fired at high elevations.

The front ends of the side pieces project beyond the transom to take the lower ends of the lifting screws and the carriage, transporting, while the rear transom is prepared to take the transporting limber.

Bearings are formed on the bed for the brake gear and fittings are provided at the travelling front to take a V-shaped connector.

The pivot plug is a hollow steel plug, screw-threaded externally at its lower end to screw into the pivot plate and internally at its upper end to receive a coned centering plug, which ensures the carriage body being in the correct position over the pivot block in mounting.

ROLLER RING.

This consists of a steel ring, around which at intervals are bolted M.B. axles, on which run flanged steel coned rollers. The outer end of each axle is fitted with a lubricating hole.

PIVOT BLOCK : UPPER PORTION.

This forms a turntable and is provided on its under surface with a hardened steel upper roller path. It has a circular bushed opening in its centre to fit over the pivot plug. It is prepared for the attachment of the holding-down clips which extend for about three-quarters of its circumference, the remainder being covered by a dust excluder.

The top is provided with four bolt holes to receive the bolts for securing the carriage body. The brackets in which the holes are bored form stops for the carriage body when mounting. A spring catch is provided on the left side to hold the upper portion to the pivot plate when travelling and just above this a lubricator is fitted for lubricating the pivot. On the right side is a bracket for the attachment of the inner end of the pedal of elevating gear clutch.

CARRIAGE BODY.

The carriage body consists of two side brackets, connected by front and rear transoms.

Trunnion bearings are provided at the top for the cradle trunnions, which are held in position by sliding capsquares secured by pins.

Two stops are fixed underneath to butt against the pivot block in mounting, to ensure the carriage body being in the correct position for bolting up.

On each side bracket is a curved ramp to take the guide wheels of the "wagon, transporting howitzer." Grooves are cut in the ramps narrowing towards the front end to ensure the correct centering of the howitzer in mounting. Steel packing pieces are provided for insertion in the grooves when found necessary on uneven ground.

Bearings are provided on the brackets for the traversing, elevating, loading and pumping gears.

Brackets are fitted to the inside at the front to take the bolts securing the carriage body to the pivot block and holes are drilled through the flanges of the rear transom to take the bolts securing the carriage to the roller cage.

The front transom has a central opening underneath to fit over the centering plug and has bearings for the inner end of the bearing tube of the rear axletree, bearings also being provided front and rear for the carriage and limber transporting.

The rear transom has a bracket bolted each side on top from which project gudgeons to fit into recesses in axletree and pins to secure the lower ends of the lifting screws. Loops are provided on the front axletree bearings to take the lower ends of the housing link.

Platforms are suspended around the carriage body in convenient positions for the numbers working the howitzer. Clips for carrying the case, "memo. of examination" are fitted on the left side.

TRAVERSING GEAR.

The traversing gear is worked from the left side and consists of a handwheel on the rear end of a short longitudinal spindle, on the front end of which is a bevel pinion. This gears into a bevel wheel on the front end of an oblique shaft supported in bearings in the left bracket of the carriage body. This shaft passes through to the inside of the bracket and carries at its rear end a bevel pinion, which gears into a similar pinion on the left end of a cross shaft supported in bearings between the carriage brackets. To the right end of this shaft is keyed a worm, which gears into a wormwheel on the upper end of a vertical spindle; on the lower end of this is a rack pinion to engage with the traversing rack on the rear transom of the bed.

The worm and wormwheel are carried in a gearcase covered in by a cap; ball-bearings are situated between the worm and its bearings at each end to reduce the friction caused by end thrust.

The gear case forms bearings for the worm and rack pinion spindle and is provided with hollow trunnions to allow the case, with pinion, &c., to be turned clear of the rack for mounting. An arm is provided for turning the case, two pin holes being provided for securing it in either the engaged or disengaged position.

TRAVERSING INDICATOR.

The carriage can be traversed 30 degrees "right" or "left" of centre. The indicator consists of a scale plate attached to the pivot plate on the left side, graduated to 30 degrees each way, read by a pointer on the pivot block catch.

ELEVATING GEAR.

The elevating gear can be worked from either side of the Mounting. The gear on the left is "slow motion" and moves the howitzer and sights together, while that on the right is a "quick motion" gear affecting the howitzer and cradle only and is used for rapidly depressing

for loading and elevating again to the firing position. A clutch is provided to disengage the "slow motion" gear, which can then be worked independently to move the sights.

The left, or slow motion gear, consists of a handwheel on the outer end of a cross spindle on the inner end of which is a bevel pinion. This engages with a bevel wheel on the upper end of an oblique shaft, which has on its lower end a worm. The worm is carried in bearings in a gear casing and has thrust collars at each end. Wear in the thrust collars can be taken up by an adjusting bush having serrated locking plates to secure it.

The worm gears into a steel wormwheel, to which is riveted the outer end of a flanged M.B. sleeve, which works in bearings in the left bracket of the carriage and has the sight elevating pinion secured to its inner end.

The sleeve is hollow and is screw-threaded internally at its outer end with a coarse left-hand thread for the reception of the clutch spindle.

The wormwheel has a bushed hole to receive the locking pin of the clutch, stops being provided to prevent the howitzer being elevated beyond the sights, should the locking pin not enter the hole correctly. Co-axial with the pin hole is cut a groove for a masking ring, which forms an inclined plane terminating in a stop. It is held in position by overhanging portions of the stops on the wormwheel and does not form a complete circle, a part being cut away to allow the locking pin to enter the hole in the wormwheel. On the back of the masking ring is a stop pin, which works in a featherway in the groove. This featherway does not extend the complete circumference of the groove and so prevents the masking ring being moved beyond its correct position at the loading angle.

The clutch consists of a steel plate provided with a short screwed boss, which screws into the flange of the sleeve on the wormwheel. The boss is hollow and feathered to the elevating arc pinion shaft. The plate is shaped to work against the stops on the wormwheel and carries the locking pin.

The locking pin is of steel, having its inner end flattened to fit the recess in the wormwheel and the outer end slotted to take one end of a short actuating lever. This lever is pivoted at its centre to a collar on the actuating shaft, which is carried in bearings in the carriage body and is hollow to receive the rod actuating the clutch gear.

The shaft has fitted to its centre a spur pinion to engage with the elevating arc. The pinion is held between two M.B. bearings on the front transom of the carriage body, the bearings being extended to form stops in elevating and depressing. The shaft is held in the right-hand bearing by a shoulder inside and a screw collar outside.

The right (or quick motion) gear consists of a handwheel on the outer end of a short cross spindle, with a spur pinion at its inner end. This gears into a spur wheel feathered to the outer end of the elevating shaft.

Friction plates are fitted into the boss of the handwheel to cushion the shock when the cradle is brought up suddenly by the elevation or depression stops.

The elevating arc is bolted to the underside of the cradle, slightly to the left of centre to clear the air pump. It is provided at its rear end with a stop pin, which fouls the bearings for the pinion at extreme elevation. Its front end is fitted with a spring buffer stop, which fouls the bearings with howitzer horizontal.

The gear actuating the clutch consists of a rod carried in the elevating cross shaft, its left end being slotted to receive one end of the lever actuating the locking pin, a spring contained in the elevating cross shaft keeps the rod and clutch up to their work. On the right end of the rod is screwed a milled head to form a bearing for the forked upper end of a bell crank lever, which is pivoted to the gear casing and has attached to its other end a short connecting rod. The lower end of this rod is connected to a foot lever.

Action.—On revolving the slow motion gear, the howitzer is elevated or depressed and the sight is moved through a corresponding angle.

To bring the howitzer rapidly to the loading position the foot lever is pressed down, and acting through the connecting rod and bell crank lever, draws the actuating rod to the right, which, through the lever at its left end, withdraws the locking pin from the worm wheel. Then, by revolving the quick motion handwheel, the elevating shaft and arc pinion are made to revolve and depress the howitzer. As soon as the gear commences to work, the foot lever should be released. The clutch in revolving with the elevating shaft unscrews from the sleeve and thus clears the stops on the wormwheel. The locking pin rides on the masking ring till it comes to the stop on the latter, when the ring is pushed round in its groove, thereby bridging the pin over its recess during the first revolution. In coming back to the firing angle, after loading, the ring is left stationary for the first revolution of the pin with the clutch, again bridging the pin over its recess and is then caused to revolve by the pin acting against the stop and moving the ring back clear of the recess in the wormwheel. At the same time the clutch has again screwed into the sleeve, and will come against the stops on the wormwheel at the same time that the pin enters the hole, thus preventing damage to the latter. The number of teeth on arc and pinion are so arranged that the elevating shaft cannot be revolved two complete revolutions, which ensures that the clutch cannot be fully unscrewed from the sleeve, and also ensures the sighting gear being in correct agreement with the howitzer after having worked the quick motion gear.

CRADLE.

The cradle consists of a steel casting having an opening to receive the howitzer. The opening has a groove each side lined with M.B., to receive the guide ribs on the howitzer.

On the underside, two collars are formed for the reception of the air cylinder, the elevating arc being bolted on underneath. Screwed into each side is a hollow steel trunnion, closed by a steel cap, a flange on which fits outside the bearings in carriage body.

The cap on the right is provided with a pointer which works over a degree scale on the carriage body to indicate the loading and approxi-

mate firing angles, while the cap on the left has a projection over which fits the supporting bracket of the sight, the latter being secured by a bayonet joint.

The upper end of the sight elevating arc fits over the left trunnion, inside the carriage bracket.

On top, at the front, is bolted a bracket to which is attached the piston rod of the hydraulic buffer. Grooves are cut along the top to take guides on the buffer cylinder and in rear of the grooves, two projections are formed for the housing bolt securing the buffer to the cradle in the travelling position. Two brackets are provided on the left side for the reception of the bolt when the howitzer is in action and on the same side a spring plunger is held in a recess to prevent the bolt being inserted when the howitzer is in the firing position.

A dust excluder is attached to the front end of the cradle.

The front underside collar has a stud each side to take the arms of the dismantling tool and a lug on the underside to take the upper end of the housing link.

At the extreme front end of the cradle is attached a trough-shaped extension to form a shield for the ram of the recuperator. The trough has a projection on each side to take the rods of the dismantling tool and has guide ribs on top for the crosshead.

A beating face, consisting of a wood block with a steel supporting bracket, is secured to the recuperator crosshead to obviate the possibility of the glands, etc., being damaged by the recoil.

TRUNNION ROLLER BEARINGS.

The trunnions are fitted with roller bearings which each consist of an inner steel roller path shrunk around the trunnion. Surrounding this is a M.B. cage containing hardened steel rollers, around which is fitted a hardened steel outer roller path. This is fitted into the trunnion bearings of the carriage body and prevented from revolving by studs. The cage is in two parts, held together by a M.B. cover secured by wire.

The rollers take the whole weight of cradle and howitzer in elevating and firing.

HYDRAULIC BUFFER.

The hydraulic buffer consists of a F.S. cylinder with guide ribs on its underside, front and rear, to slide in the grooves on top of the cradle. An opening is bored horizontally through the rear end to receive the housing bolt.

The rear end of the cylinder is closed by a hollow steel plug, which forms a control chamber, screwed in against a leather washer. The howitzer is secured to this plug by a nut and shoulder.

The cylinder has two spiral grooves inside to take the studs on the rotating valve and the front end is screw-threaded to receive the stuffing box. On the front and rear ends, locking plates are fitted to prevent the stuffing box and rear plug from unscrewing. A drain hole, closed by a screw and washer is provided at the rear end.

On top is bolted a tank, with filling and air plugs. The tank is connected to the rear end of the cylinder by a pipe. The front end of

the cylinder is provided with an air-hole closed by a plug and leather washer and also an air-release valve to release any air which may accumulate during firing. The air-release valve consists of a steel valve fitted in a hollow plug, the inner end of which forms a seating for the valve. On the upper end of the valve spindle is screwed and pinned a nut and between the nut and a shoulder in the plug is a spiral spring to keep the valve closed. On the right side of the tank are two brackets to support a rod, the rear end of which is provided with a handle and the front with a cam, the latter being arranged so that when the handle is raised it presses down on the valve and opens it against the pressure of its spring and allows the air to escape. On releasing the handle the spring forces the valve back into its seating.

The front end of the cylinder is closed by a steel stuffing box which screws in against a cup-shaped leather washer and metal supporting ring, the flange being serrated to take the locking plates which prevent unscrewing. It is recessed to take an "L"-shaped rubber, secured by a G.M. supporting ring screwed in. In front of this is placed a ring of Dick's packing between two G.M. supporting rings, the whole being secured by a gland which is prevented from unscrewing by a spring plunger carried in a recess in the stuffing-box, the flange of the gland being serrated for this purpose.

Working in the cylinder is a piston, piston rod and control plunger of steel in one forging. The rod passes through the stuffing-box to the front and is secured to a bush in the bracket on the cradle by a collar and nut.

The piston has segments of a ring of M.B. dovetailed into its periphery to prevent scoring the buffer and has two ports cut into it to allow the passage of liquid. Against the rear face of the piston is placed a M.B. rotating valve held by a collar feathered to the plunger, and a nut and pin, in such a way that it can revolve around the rod. This valve has two studs, or feathers, formed on it to work in the spiral grooves in the cylinder and two ports to allow the passage of liquid as the howitzer recoils. These ports are so shaped as to graduate the pressure throughout recoil. Oil holes and grooves are provided in the rotating valve to lubricate the bearing surfaces.

The front end of the control chamber is bushed with M.B. through which works the control plunger. This tapers slightly at its rear end and is a close fit to the bush in the mouth of the chamber. A radial channel is cut from the control chamber communicating with the buffer through an oblique channel. Into the radial hole is screwed an adjustable plug, the stem of which is reduced leaving an enlarged head on which two flats are filed to allow liquid to pass from the control chamber to the oblique channel thence to the cylinder, to suit the run up.

Action.—As the howitzer recoils, it draws the buffer cylinder to the rear over the piston which meets with the resistance of the liquid in the cylinder. The liquid is allowed to pass through the ports of piston and rotating valve, the studs on the latter working in the spiral grooves in the cylinders, causes it to turn, which moves the ports away from the ports in the piston, shuts off the flow of liquid as the

recoiling velocity decreases and so graduates the pressure and brings the howitzer to rest.

As the recuperator returns the howitzer to the firing position, the control plunger enters the control chamber and displaces the liquid gathered there during recoil. The liquid can only escape over the flats on the adjustable plug, through the oblique channel and back to the cylinder, the size of the flats on the plug being regulated to prevent the howitzer returning with violence.

CUT OFF GEAR.

This gear is designed to act so that the length of recoil is automatically reduced from 44-inches when the howitzer is fired horizontally, to 20-inches when it is fired at 50°. This shortening of the recoil is not uniform, but increases gradually from .8-inch between 0° and 5° elevation to 3.8-inches between 45° and 50° elevation.

The gear is situated on the right side and consists of a collar which fits round the right trunnion of the cradle, secured from turning by a projection of the capsquare. This collar has an arm projecting to the front, to which is pinned an actuating link. This is in two parts, the front portion screwing on the other to make it adjustable, a pin secures the front part from turning, the screwed portion being slotted for the pin. The words "lengthen recoil" and "shorten recoil," with indicating arrows, are engraved on the front or nut portion. This adjustment should only be used in case of wear. To the front end of the actuating link is pinned a lever on a cross spindle to the inner end of which is feathered a bevel segment. This gears into bevel teeth on the bush to which the piston rod is feathered. On the opposite side to the teeth, the bush is serrated so that if the gear is damaged the bush can be locked in the required position for any particular angle of elevation, an arrow on the bush reading a scale on the bracket.

Action.—As the howitzer is being elevated, the difference in the positions of pivot of cradle and actuating link causes the latter to move back with relation to the former and turns the cross-spindle; the bevel segment on its inner end causes the bush and piston rod to turn, thus decreasing the openings between the ports of piston and rotating valve. By decreasing the space through which the liquid can pass as the howitzer recoils, the pressure in the buffer is increased and the recoil shortened accordingly. The method of setting the cut-off gear is as shown on Plate XXII.

RECUPERATOR.

The howitzer is returned to the firing position after recoil, by means of compressed air contained in a recuperator cylinder. The pressure of the air acts upon a floating piston, which in turn acts through liquid upon a ram attached to the howitzer.

The air cylinder consists of a steel cylinder inserted in the collars on the underside of the cradle, secured to the front collar by a shoulder and nut and prevented from turning by a feather. The rear end of the cylinder is closed by a plug which screws in against a Klingerite

washer. The plug is provided with a filling stop-cock and a connection for gauge and air-pipe of pump.

The front end of the cylinder is closed by a steel stuffing box which screws in against a leather washer. Inside the stuffing box is placed two rubbers of "U" section with supporting rings, held in position by a supporting ring screwed in. In front of this is a ring of Dick's material between two supporting rings, the whole being held by a steel gland screwed in.

The front end of the cylinder is provided underneath with a drain-hole closed by a screw with leather washer.

Working inside the cylinder is a hollow steel ram, having on its rear end an external screwed stop collar; the external diameter of the ram being less than the internal diameter of the cylinder.

The front end of the ram is connected to a cross-head by a feather and featherway and a nut. The cross-head slides in the trough-shaped shield attached to the cradle and is connected to the howitzer by a steel cotter with keep pin.

The front end of the ram is shaped internally to form a stuffing box to receive packing similar to that in the front end of the air cylinder. The gland is prevented from turning by two feathers formed on an indicator tube which surrounds the tail rod of the floating piston. The ram is provided at its front end with filling and air plugs.

Inside the ram and air cylinder works a floating piston, to form a barrier between the air and liquid, to prevent aeration and to form an intensifier, to prevent leakage of air by opposing a superior pressure of liquid to it.

The floating piston is of hollow steel, the front end being reduced in diameter to form a tail rod which works through the gland in the front end of the ram. It has a stop plate secured to its front end by three screws, to prevent it being forced through to the rear of the gland when charging the system. A line is cut around the front end of the tail rod to act as an indicator for the quantity of liquid inside the ram. The front end of the tail rod is surrounded by an indicator tube pinned to the cross-head, the tube having a slot cut along its left side to expose the index on the tail rod. Above the slot the tube is marked with a scale of inches from 0 to 10 and below with a scale of pints from 0 to 10. The slot is covered by a hinged shutter. The rear end of the tube is enlarged to fit over the tail-rod gland, two feathers on the tube engaging featherways on the gland to prevent it unscrewing. At the shoulder between the body of the floating piston and its tail rod is screwed a G.M. bearing ring with ports for the passage of liquid during recoil and run-up. The floating piston is slightly less in diameter than the interior of the ram and is hollow to increase the air capacity.

Surrounding the rear end of the piston are two "U" rubbers, with supporting rings, both facing the liquid, held between two screw collars. Behind the rear securing ring is a cup rubber, facing the air, held by a ring screwed to the rear end of the floating piston. The collars and ring are secured by set screws.

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Action.—During recoil the ram is forced into the air cylinder and acting upon the liquid, forces the floating piston to the rear, thus increasing the air pressure. The ram being of lesser diameter than the air cylinder, leaves a space to be filled by liquid and consequently the floating piston does not move so far as the ram. The recoil energy having been absorbed by the hydraulic buffer, the air expands and forces the floating piston forward; this, acting through the liquid, forces the ram to the front, thus returning the howitzer to the firing position.

PUMP, AIR, TWO-STAGE, VERTICAL, No. 1.

(Plates XXIII and XXIV.)

As described for Mark I equipment, pages 23 and 24.

LOADING GEAR.

The loading gear is carried on the left bracket of the carriage in rear of the ramp and consists of a spur quadrant fixed on the lower end of a steel loading arm. The arm is provided with a sleeve which passes through a bearing in the carriage body from the inside, secured outside by a screwed collar and pin. The quadrant and arm are free to rotate around this point and can be removed for transport by unscrewing the collar.

The upper end of the loading arm is provided with a spindle to support the loading tray. To this spindle is attached one end of a short lever, the other end of which is attached to a link, by means of which the loading tray is kept horizontal throughout its movement. The lower end of the link is pivoted to a projection on the bearing for the loading arm. The spindle also carries two clips which fit under lugs on the loading tray.

Into the quadrant gears a spur pinion on the inner end of a short cross spindle supported in bearings in the carriage body and actuated by a train of spur gear and a winch handle.

The winch handle spindle is provided with a ratchet and pawl to retain the loading arm in any required position.

Two loading trays are provided, shaped to fit into the breech opening, their rear ends being flanged to prevent the shell slipping out.

A recess is cut in the ramming platform to receive the tray and shell.

Action.—The howitzer is brought to the horizontal position by the quick motion elevating gear and breech opened.

A tray with shell is placed into the recess in the ramming platform.

On working the winch handle, with pawl disengaged, the clips on the arm engage under the lugs of the loading tray. The pawl is then

dropped and the winch handle turned in the opposite direction, which raises the loading arm and tray and swings the latter with the shell into the breech opening. The shell is rammed home by hand, loading arm lowered and tray removed.

A bearer loading tray is provided for placing the tray with shell on the ramming platform, or in the case of breakdown of the gear it can be used to lift the shell up to the breech of the howitzer.

A shell bearer is provided for bringing the shell to the howitzer, and consists of a wood bar with a lifting handle at each end and two pairs of "grab" arms in its centre to grip and lift the shell.

A "Lifter, projectile" will be issued so soon as existing stocks of "bearers, loading tray" and "bearers, projectile" are used up. The new lifter consists of a pair of steel grips provided with tubular steel handles, the latter being stopped at the ends with wood plugs. The grips are connected together centrally by an axis bolt with nut and keep pin and provided with a stop plate to limit the opening of the jaws, the plate being bent over the sides of the grips and secured in position by the axis bolt. The jaw portion of each grip is in the form of two curved arms, the end of each arm being cross-grooved, case-hardened and prepared with a curved face to ensure an efficient hold on the projectile.

HOLDFAST, B.L. 9·2-INCH MARK II SIEGE CARRIAGE, MARK I.

The holdfast for the Mark II equipment is similar to that described on page 25 for the Mark I equipment.

TRANSPORTING VEHICLES.

Wagon, transporting, B.L. 9·2-inch Howitzer, Mark II.

Carriage, transporting body and cradle, B.L. 9·2-inch Howitzer, Mark II.

Carriage, transporting bed, B.L. 9·2-inch Howitzer, Mark II.

Limber, transporting, body and cradle, B.L. 9·2-inch Howitzer, Mark II.

Limber, transporting bed, B.L. 9·2-inch Howitzer, Mark II.

The above-mentioned vehicles are similar to those described for the Mark I equipment on pages 26 to 28, but are not interchangeable, being different in dimensions to suit the Mark II equipment.

LIST OF LUBRICATING HOLES FOR TRANSPORTING VEHICLES,
B.L. 9.2-INCH MARK II HOWITZER EQUIPMENT.

Vehicle.	Number.	Where situated.
Wagon transporting Howitzer.	14	3 in gear casing of traversing gear. 1 in body for sliding surface on axle tree. 2 in gear casing of raising gear. 2 in bearings for winch handle shaft of hauling gear. 3 over pivot of fore carriage. *1 in axis of hauling chain wheel front end. 1 in axis of each guide roller.
Limber transporting body and cradle.	3	On top of framework for lubricating locking gear (Ackermans Lock).
Carriage transporting body and cradle.	2	1 on each side for brake gear.
Limber transporting bed.	3	On top of framework for lubricating locking gear (Ackermans Lock).

* Holes only, remainder fitted with screws and chains.

CARE AND PRESERVATION OF MARK II CARRIAGE, &c.

Before firing, all gears on the carriage and all working surfaces should be well lubricated and worked to ensure their working easily and correctly. A list of lubricating holes and lubricators is given on page 55. These holes should be kept clear of dirt to allow the oil a free passage to the working parts, the holes being closed by their screws or covers when not actually being used. The lubricant used is oil, except that in assembling any gear which is covered in by a casing, the gear casing is filled with grease in order to lubricate all the wheels and pinions so enclosed. Any wheels, &c., not so enclosed should be cleaned and greased.

HYDRAULIC BUFFER.

The buffer cylinder must be kept filled with the correct quantity of liquid, correctly attached to the howitzer, and split-pin inserted. The exposed part of the piston rod should be kept clean and lightly coated with mineral jelly and the cut-off gear should be examined to see that it is working correctly and should be kept well lubricated.

The guide faces and grooves of cradle and buffer should be carefully cleaned and lubricated before firing and coated with mineral jelly when dismounting.

To fill the cylinder.—Lay the howitzer horizontal, remove air and filling plugs in tanks and air plugs in buffer. Pump in oil until it overflows at air hole of buffer; replace plug. Continue filling till oil overflows at air hole of tank; replace plugs.

Quantity of buffer oil required; about 12 gallons.

Buffer.—Should leakage occur at the stuffing box which cannot be stopped by tightening up the gland the soft packing must be replaced by new.

To replace the soft packing.—Disconnect the recoil control gear and piston rod from the front bracket. Unbolt and remove the bracket and remove the securing collar from the piston rod. Elevate the howitzer a few degrees, unscrew and remove the gland. Remove the supporting ring and soft packing and replace it by new, taking very great care not to damage it in passing it over the threads of the piston rod. Replace supporting ring and screw in and secure the gland. Replace securing collar, bracket, securing nut and connect up recoil control gear. Make good any leakage which has occurred by refilling buffer in the usual way.

A defective L-rubber will be indicated by leakage occurring during firing; and tightening up the gland will not remedy this defect so the L-rubber must be replaced.

To replace the L-rubber.—Empty the buffer, then proceed as described for replacing soft packing and after removing inner supporting ring, unscrew the protecting ring for the rubber. Remove the rubber and place in the new one, taking very great care that it is not damaged by the threads of the piston rod and also that it fits accurately into the recess in the stuffing box around the piston rod. Screw in the protecting ring for rubber, replace the soft packing, with the inner and outer supporting rings, connect up piston rod, bracket and recoil control gear and refill the buffer.

Should the cup leather washer for stuffing box be faulty the stuffing box must be unscrewed and the cup leather washer replaced by a new one, taking care that it fits accurately around its supporting ring.

To replace the leather washer for the rear plug the buffer must be emptied, the howitzer must be disconnected and drawn back a convenient distance and secured in that position. The plug can then be unscrewed. The new washer should be first well rubbed with dubbing and the plug well cleaned. Place in the washer and screw in the plug. Force the howitzer to the front and connect up to the plug by its securing nut. Refill the buffer.

RECUPERATOR.

To charge the recuperator, as described on page 29 for Mark I equipment, the quantity of oil required being about 4-gallons. Before firing, the indicator at the front should be examined to ensure that the recuperator contains a sufficiency of liquid. If leakage occurs the floating piston will move to the front and the mark on the tail rod of the floating piston will indicate the amount of leakage on the scale provided. This must not be allowed to exceed 10-pints. The air pressure should also be tested as follows:—

Connect up the gauge, ease back stop valve and if the pressure gauge reads below 350-lbs. connect up the air pump and pump till gauge shows 475-lbs. per square inch. Close stop valve, disconnect gauge and pump and replace plugs.

The ram should be cleaned and oiled before firing and should also be occasionally wiped during firing to prevent dust and grit being worked into the packings. All glands should be examined. and tightened if leakage is occurring. If tightening the glands

does not stop the leakage, the packings should be exchanged as follows :—

To replace the packing in tail-rod gland.—Secure the howitzer to the cradle, exhaust the air pressure and drain off the liquid. Unpin and remove the indicator tube from the crosshead, remove the stop plate from front end of tail rod. Unscrew the gland and remove the soft packing with its supporting rings. If the U-rubbers require replacing, unscrew the protecting ring for rubber and remove the rubbers with their supporting rings. Place in the new rubbers with their supporting rings, taking care not to damage them and also to see that they fit correctly into position, screw in the protecting ring, replace the soft packing with its supporting rings, screw in the gland and replace stop plate and the indicator tube. Recharge with liquid and air.

To repack the ram gland.—Secure the howitzer to the cradle, exhaust the air pressure and drain off the liquid. Disconnect and remove the indicator tube. Disconnect the ram from the crosshead and force it into the air cylinder. Remove and replace the packings as described for tail-rod gland.

Afterwards draw the ram to the front and connect up to cross-head, replace indicator tube and recharge with liquid and air.

To replace the rubbers on the floating piston.—Secure the howitzer to the cradle, exhaust the air pressure and drain off the liquid. Disconnect and remove the indicator tube and cross-head, strip the tail rod gland and ram gland. Remove ram and floating piston to the front, unscrew the collars securing the rubbers on the floating piston and remove the rubbers with their supporting rings. Replace with new ones, securing them by their screwed collars. Replace the floating piston into the air cylinder taking care that the L-rubber is not distorted or any of the rubbers damaged. Replace the ram and push it into the air cylinder. Replace the ram gland with its rubbers and packing. Connect up the ram to the crosshead and repack the tail rod gland. Replace indicator tube. Recharge with liquid and air.

When not in use, the ram should be lightly coated with mineral jelly and covered with the canvas cover provided.

CRADLE.

Before mounting or dismounting the howitzer, the securing link at the front end of the cradle should be secured by the pin.

Before mounting, care should be taken to thoroughly clean the howitzer guide ribs and their grooves, cleaning out the oil channels particularly and well lubricating the howitzer guide ribs.

The trunnion roller bearings must be kept well lubricated.

SIGHT.

The sight should be kept perfectly clean and free from grit, all working parts well lubricated. When not in use it should be lightly coated with mineral jelly and covered with the canvas cover.

Before firing, the sight should be tested and adjusted if necessary.

Very great care should be exercised at all times to ensure that the spirit levels and any alignment adjustments are not disturbed.

ELEVATING GEAR.

When carriage is assembled and also before firing, the teeth of the elevating arc and gears should be cleaned and greased and the gear well lubricated.

When equipment is travelling, working parts should be coated lightly with mineral jelly to prevent rusting.

TRAVERSING GEAR.

When assembling the carriage, the roller path and rollers should be thoroughly cleaned and lightly oiled and before engaging the traversing pinion, all parts should be lubricated thoroughly.

All gears on the transporting vehicles should be kept thoroughly cleaned and lubricated. the brakes examined to ensure their efficiency, raising screws cleaned and oiled, the nuts being run by hand the full length of the screw, and the pawls examined to ensure efficient working. When mounting the howitzer care should be taken that the brake gear of the howitzer wagon is in the housed position, otherwise the handwheels may be damaged.

When assembling the earth box, the pins, &c., should be coated with mineral jelly.

AIR PUMP.

(See pages 31 to 34.)

LIST OF LUBRICATING HOLES B.L. 9.2-INCH MARK II. HOWITZER CARRIAGE.

Part lubricated.	Number.	Where situated.
Pivot plug	1	Left side of upper portion of pivot block.
Roller ring	25*	1 in outer end of each roller axle.
Roller cage	6*	1 for each roller axle.
Connection for limber transporting bed.	2	On top of swivel tube connection.
Cradle	11	1 on top of each capsquare for roller bearings. 4 along each side for guideways. 1 on spring stop of elevating arc.
Cut-off gear	3	1 in trunnion collar. 2 in bracket supporting bevel segment spindle.
Traversing gear	5	2 on handwheel spindle gear casing. 1 on worm wheel gear casing. *2 in bearings for worm spindle, 1 either end of the worm.

* Holes only, remainder fitted with screw and chains.

LIST OF LUBRICATING HOLES B.L. 9·2-INCH MARK II. HOWITZER
CARRIAGE—*continued*.

Part lubricated.	Number.	Where situated.
Elevating gear	10	3 on upper gear casing left side. 2 on lower gear casing left side. 1 on gear casing right side. 4 in bearings for elevating shaft inside carriage brackets.
Loading gear	8	6 on gear casing. 2 in bearings top of arm for cross spindle.
Sighting gear	7	1 in circular collar of arc which fits around trunnion. 2 in supporting bracket. 4 spring lid lubricators for sight gear.
Pump	4	1 Automatic. 1 with feed pipe. *1 in each outer bearing of winch handle shaft.

* Holes only, remainder fitted with screws and chains.

SIGHTING, MARK II EQUIPMENT.

The sighting arrangements are similar to those described on pages 34 to 38 for Mark I equipment, the principal difference being that the Mark I sight is set at a permanent angle of 3° to compensate for drift and has no permanent deflection correction, while the Mark II has a permanent angle of 4° to the left and a permanent right deflection of 30 minutes to compensate for drift.

CARE AND PRESERVATION OF SIGHTS.

As described on pages 38 and 39 for Mark I equipment.

INSTRUCTIONS FOR TESTING AND ADJUSTING SIGHTS.

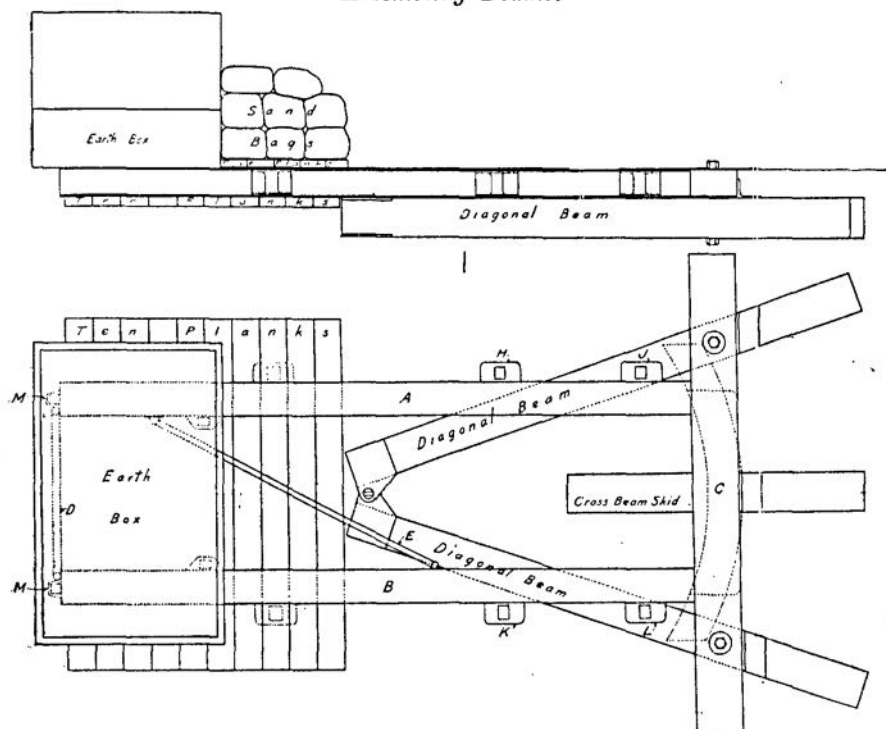
As described on pages 39 and 40 for Mark I equipment, with the following exceptions:—

- (1) In the alignment tests, care must be taken to use the correct target (Plate XXX), also to remember that the true zero is also the working zero, this sight having no permanent deflection correction.

INSTRUCTIONS FOR ASSEMBLING THE CARRIAGE AND MOUNTING THE HOWITZER.

(MARKS I AND II EQUIPMENTS.)

Assembling Beams.



1. Excavate the ground for holdfast (described on page 25), lay the ten planks, two diagonal beams and cross beam skid in the cavity and level them.

2. Then place the beams A, B and C on top and flush with the ground.

3. Adjust the beams by placing the tie rods D and E into their sockets.

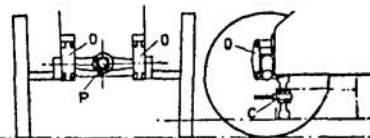
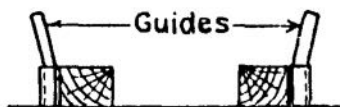
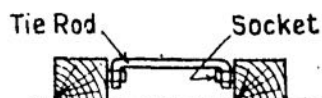
4. Connect the cross beam to the diagonal beams.

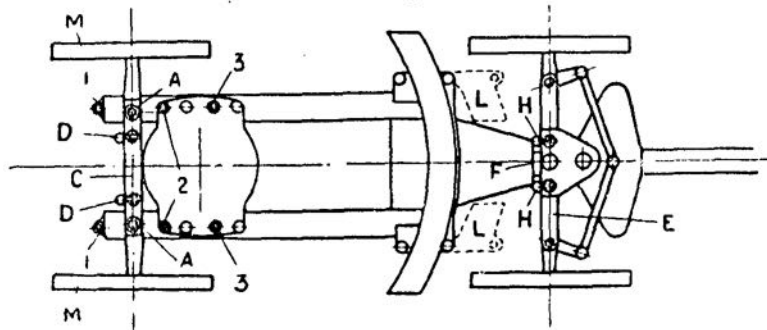
5. Place the bed guides in position at H, J, K and L.

6. Ram in the earth round the beams and make it level with top of beams.

7. Remove, preserving screws from holding down bolt holes.

NOTE.—Front ends of beams A and B are distinguished by sockets M M.



Assembling Bed.

1. Pass two of the lifting screws through the axle C and into the bed at A, A, and secure by their respective pins.

2. Screw down the nuts on the lifting screws to take the weight off the locking pins D, D, and remove pins D, D.

3. Pass the third lifting screw through the limber axle E and into the bed at F, and secure it by the locking pin, then remove the pins H H locking the limber axle.

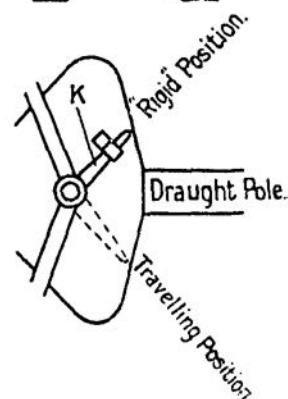
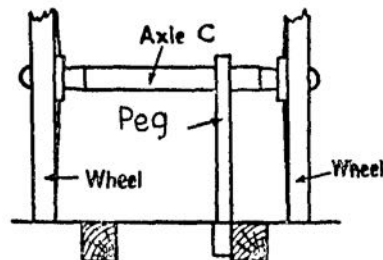
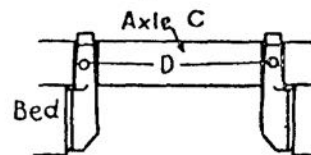
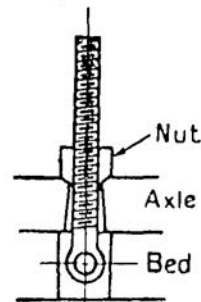
4. Back the bed into position over the beams until the axle C stops against the upright peg J, and see that the bed is approximately parallel with the beams.

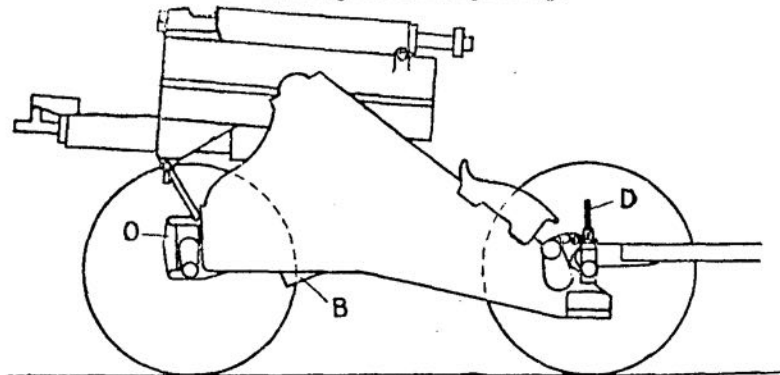
5. Lower the bed on to the beams by means of the ratchets and screws at A, A, F, and make draught pole rigid by moving lever K.

6. Secure the bed to the beams by the holding-down bolts 1, 2 and 3.

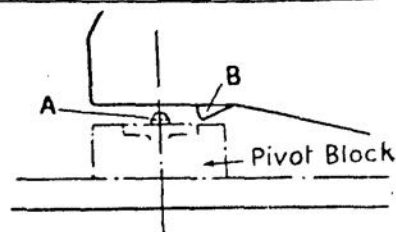
7. Turn back the hinged portions L of roller path to allow wheels of carriage body to pass.

8. Remove the limber and roll away the transporting wheels M M with the axle C intact.



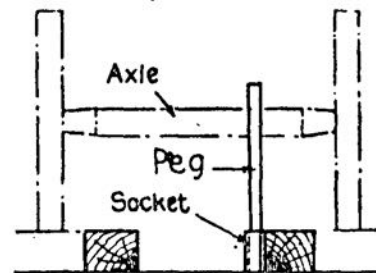
Assembling the Carriage Body.

1. Back the carriage body over the bed so that the front holding-down bolt holes are approximately in line with those in the pivot block. The centring pivot A and plates B will then automatically locate the carriage body correctly in lowering.

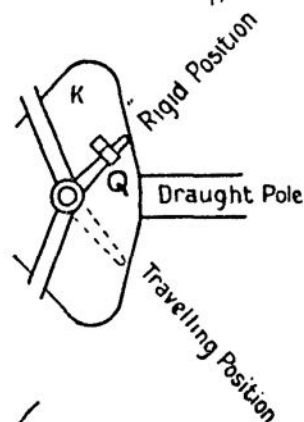


2. Place the two screw jacks C under the front end, and by this means take the weight off the two wheels.

Open the axle hinged brackets O and remove the nut P from the axle centre pivot. Then roll away the rear transporting limber.

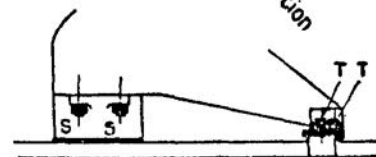


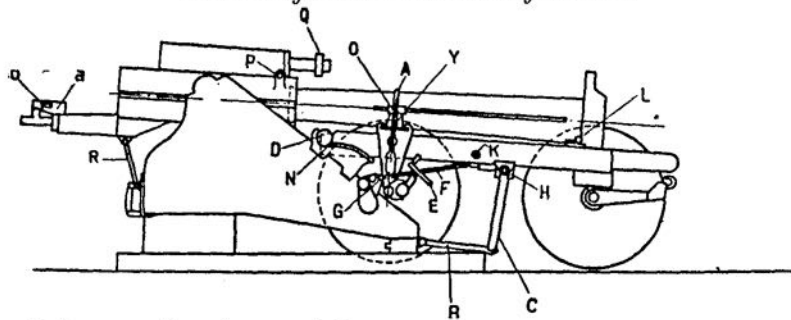
3. Make the draught pole rigid by the locking lever Q. Remove the pins securing the lifting screw nuts and then lower the carriage body by means of the screw jacks and lifting screws D, simultaneously.



4. Take out pins from lifting screws and remove the limber.

5. Secure the carriage body to the pivot block by the holding-down bolts S. S. and to the rear bearing plate top of roller path by bolts T. T.



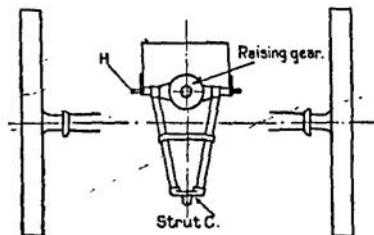
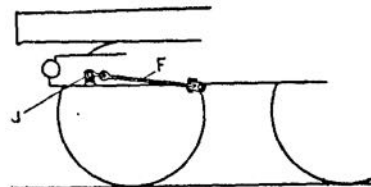
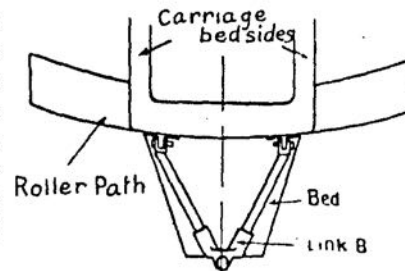
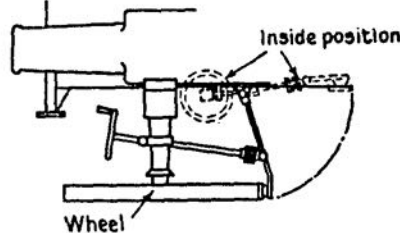
Assembling Howitzer in Carriage Cradle.

1. Remove the wire rope A from howitzer, release the retaining pawls at breech end by removing spring pin L, and take out the locking pin M securing the wagon to axle, house the brakes in the inside position and release the V-shaped thrust bar R on the carriage bed.

2. Back the transporting wagon into position so that the guide rollers D are approximately in line with the ramps N on the carriage body, and the strut C in line with the thrust bar B, working, if necessary, both traversing gear on the carriage bed and the winch gear E on the wagon.

3. Place the winch handle on the spindle H, take out the housing pins J, turn the handle so that the side rods F are moved forward, secure rods F to the carriage body by the pins G and turn the handles in the reverse direction—noting that the strut C rests upon the thrust bar B as soon as practicable. Again turn the handles until the wagon is raised from the ground and is in its extreme forward position.

4. Elevate the cradle until in line with the howitzer, then place the handles on the spindle K and haul the howitzer along until the keys are about to enter the keyways. Adjust the cradle so that the top clearance for the keys is about twice the amount of the clearance on the underside (this is necessary, as it takes up any backlash in the elevating gear, and results in the howitzer being lifted



Assembling Howitzer in Carriage Cradle—*continued.*

slightly as it is hauled into the cradle, thus relieving the front supports O of weight and allowing them to be readily withdrawn to clear the breech ring) and continue to haul the howitzer until the breech ring approaches the front supports O.

5. Take out spring pins Y securing supports O and withdraw supports to allow breech ring to pass. Remove the pin P securing buffer for travelling, also recoil cylinder nut Q, and haul the howitzer home to its firing position in the cradle.

6. Remove the pin Z and disconnect the hauling chain from the howitzer and let down the wagon on to the ground, then release the side rods from the carriage body and remove transporting wagon complete, house the side rods F for travelling and also the strut C.

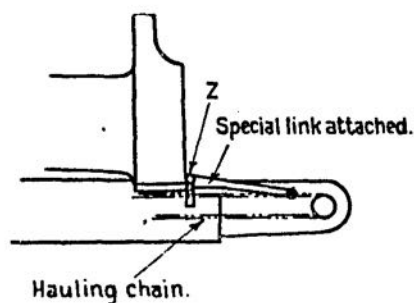
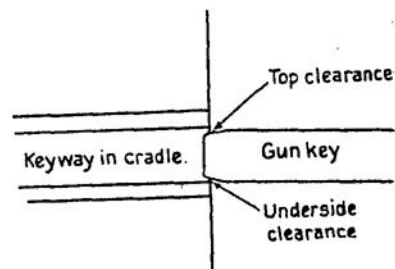
7. Screw on the recoil cylinder nut Q and make secure. Fix the apparatus securing recuperator ram to front end of cradle and adjust the slipper "a" to enable the cotter "b" to be fitted in; secure the cotter and remove the apparatus.

8. Swing out and fix into firing position the hinged portion of roller path, take out pin securing traversing pinion and spindle, drop the pinion into gear with the traversing rack and secure it there. Place the pegs into their sockets and drive into the ground.

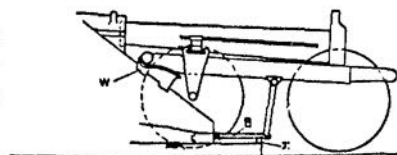
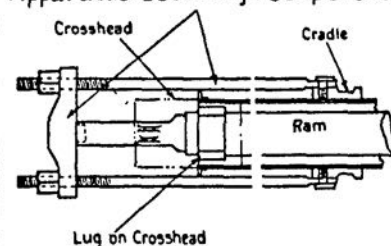
Assemble the loading arm in its socket, bring up the loading platform and secure it to carriage body. Also fix the side steps.

9. Fix the earthbox in position by placing the uprights U in the sockets V on the beam.

NOTE.—Packing pieces W for the ramps and X for the link B are provided for cases when the bedplate is sunk lower than the ground.



Apparatus securing recuperator ram



*Dimensions, Weights, &c. (Mark I Equipment).**Carriage Bed* (including front axle) with earth box
and loading platform packed on the bed—

Total weight (without wheels)	..	..	..	4 tons 5½ cwt.
Weight—				
With earth box	{	on front axle	..	1 ton 17¼ cwt.
		„ rear „	..	2 tons 8¼ cwt.
Without earth box	{	„ front „	..	1 ton 11 cwt.
		„ rear „	..	2 tons.
Measurement tonnage	..	..	..	18 tons.
Weight of earth box	..	..	..	14½ cwt.
Total length (without pole)	..	..	..	19 ft.
„ (with pole)	..	..	..	28 ft. 3½ in.
Total height (on wheels)	..	..	..	5 ft. 5½ in.
Total width	..	..	..	8 ft. ½ in.
Distance between axles	..	..	..	13 ft. 4 in.
Angle of lock	..	..	..	40 degrees.

Carriage Body (with cradle)—

Total weight (without wheels)	..	..	..	4 tons 5 cwt.
Weight on front axle	..	..	..	1 ton 11¼ cwt.
„ rear „	..	..	..	2 tons 14 cwt.
Measurement tonnage	..	..	..	28 tons.
Total length (without pole)	..	..	..	17 ft. 9½ in.
„ (with pole)	..	..	..	26 ft. 11 in.
Total height (on wheels)	..	..	..	8 ft. 7½ in.
Total width	..	..	..	8 ft. ½ in.
Distance between axles	..	..	..	9 ft. 7 in.
Angle of lock	..	..	..	32 degrees.

Transporting Wagon (with howitzer)—

Total weight (without wheels)	..	..	..	4 tons 3 cwt.
Weight on front axle	..	..	..	2 tons 5 cwt.
„ rear „	..	..	..	1 ton 18 cwt.
Measurement tonnage	..	..	..	19 tons.
Total length (without pole)	..	..	..	13 ft. 10 in.
„ (with pole)	..	..	..	22 ft. 11 in.
Total height (on wheels)	..	..	..	7 ft.
Total width	..	..	..	8 ft. ½ in.
Distance between axles	..	..	..	7 ft. 4 in.
Angle of lock	..	..	..	36 degrees.

Anchoring Arrangements—

Total weight	..	..	..	1 ton 12 cwt.
Measurement tonnage	..	..	..	6 tons.

Wheels—

5-ft. diameter, 6-in. tire.				
Twelve in number—weight of each	..	..	..	3 cwt.

The loads can be conveniently carried on their wheels in railway trucks.

As regards the following :—

The *carriage bed* cannot be sub-divided, except by the removal of the wheels.

The *carriage body* could be sub-divided as follows :—

<i>Cradle</i> , weight	2½ tons.
Measurement tonnage	14 „
<i>Carriage body</i> , weight	1½ „
Measurement tonnage	14 „
<i>Axles</i> (front and rear together), weight	11 cwt.
Wheels (four)—weight of each	3 „

The wagon, transporting howitzer, must travel mounted on its wheels to prevent damage, since the under frame does not permit of the load being placed on the ground without the wheels. If the howitzer be removed, the weights are as follows :—

Transporting wagon (with wheels)	1 ton 15 cwt.
Howitzer (approximate)	3 tons.

Radius of turning circle (<i>en train</i>)	19 ft.
Track of wheels	7 ft. 4 in.

DIMENSIONS, WEIGHT, &C., MARK II EQUIPMENTS.

						tons cwts. qrs. lbs.			
Carriage and limber, transporting bed :—									
Carriage with draught link and two lifting screws						0	13	0	3
1 draught link						0	0	2	8
2 lifting screws						0	0	3	2
Limber with 1 lifting screw						0	18	0	27
1 lifting screw						0	0	1	5
Total weight { travelling condition without earth box						5	12	0	20
						4	13	0	17
Weight on ground { front axles rear axle						2	11	2	14
						3	0	2	6
Measurement tonnage						23	10	0	0
Total length { without connector with connector						ft.		ins.	
						20		9	
						23		1	
Greatest height (top of wheels)						5		0	
Greatest width (over end of axles)						9		1	
Distance between axles (wheel base)						14		6	
Wheel track						8		0	
Angle of lock { R L								39°	
								40°	

				tons cwts. qrs. lbs.			
Carriage and limber, transporting body and cradle :—							
Carriage with brake gear	..	..	..	0	15	1	14
Limber with 2 lifting screws	..	..	..	0	16	2	21
2 lifting screws	..	..	..	0	0	2	13
Total weight (travelling condition)	..	..	..	6	11	3	21
Weight on ground { front axle	..	..	..	2	8	3	14
rear axle	..	..	..	4	3	0	7
Measurement tonnage	..	..	..	41	0	0	0

				ft.	ins.
Total length { without connector	..	..	..	19	8
with connector	..	..	..	21	11
Greatest height (top of gravity tank)	..	..	..	9	3
Greatest width (over ends of axle)	..	..	..	9	1
Distance between axles (wheel base)	..	..	..	10	9
Wheel track	..	..	..	8	0
Angle of lock { R	..	..	..	30°	30"
L	..	..	..	36°	15"
Turning circle (diameter)	..	..	..	25	

				tons cwts. qrs. lbs.			
Wagon, transporting howitzer :—							
Weight of howitzer, including breech	..	..	..	4	5	0	17
Weight of transporting carriage	..	..	..	2	6	0	17
Weight on ground under wheels { front axle	..	..	..	2	15	2	6
rear axle	..	..	..	3	15	3	0
Measurement tonnage	..	..	..	26	12	0	0

				ft.	ins.
Total length { without connector	..	..	..	16	6
with connector	..	..	..	19	3
Greatest height (top of howitzer lug)	..	..	..	7	2
Greatest width (over end of axles)	..	..	..	9	1
Distance between axles (wheel base)	..	..	..	8	0
Wheel track	..	..	..	8	0
Angle of lock	..	..	..		37°
Turning circle (diameter)	..	..	..	35	0

				tons cwts. qrs. lbs.			
Beams, firing	{ R.H.	..	..	0	19	1	0
	{ L.H.	..	..	0	19	1	0
	{ Rear	..	..	0	11	2	7
	{ 2 diagonal stays	..	..	0	0	3	3
Total weight				2	10	3	10

Ramp for wheels :—

tons cwts. qrs. lbs.

Total weight, 2 ramps				0	4	3	2
Packing dimensions :—				ft. ins.			
Earth box	length	..	..	..	..	9	0
	height	..	..	..	..	2	6
	width	..	..	..	..	6	0
Firing beams	length	..	..	..	..	19	7
	height	..	..	..	..	1	0
	width	..	..	..	..	5	9
Ramps for wheels	length	..	..	..	..	11	10
	height	..	..	..	..	0	9
	width	..	..	..	..	1	0

AMMU

Projectiles.					
Description.	Mark.	Fuze-hole.	Weight. Filled and Fuzed.	Bursting Charge.†	
				Nature.	Weight.
			lb.		lb. oz.
Shell, B.L., H.E., 9·2-inch howitzer.	XIVA‡	2-inch	290	—	26 8
	XVA‡	2-inch	290	—	26 7½
	XVIA‡	2-inch	290	—	43 9½
	XVIA‡	2-inch	290	—	43 11
	XVIII	2-inch	290	—	31 10
	XIX	2-inch	290	—	40 12
Shell, B.L., Chemical, 9·2- inch howitzer.	IA	2-inch	—	—	—
Shell, B.L., Common, pointed, 9·2-inch howit- zer.	IA	2-inch	290	—	23 12
Projectile, Practice, B.L., 9·2-inch howitzer.	II	G.S.	290	L.G.	20 13½

† And exploder.

‡ Mark II howitzer only.

NITION.

Nature of Fuze.	Cartridge.			
	Nature.	Weight.	Size.	Means of Firing.
		lb. oz.		
FUZE LIBRARY OF FACTORIES	Percussion, No. 101B with gaine No. 2.	Cordite M.D.	30 5†	15
	Percussion, with cap No. 106§ or No. 106E.	N.C.T.	32 10‡	20
	Fuze, time, No. 188M, with adapter No. 12 and gaine No. 2 (for air-ranging).	Cordite M.D.T. or R.D.B.T.	23 12¶	20-10
		N.C.T.	26 15‡¶	19
		N.C.T.	13 1‡**	19
		Cordite M.D. or R.D.B.	11 13**	12
	Fuse, percussion, with cap No. 106E.	Cordite M.D.T.	10 14‡**	20-10
	Fuze, percussion, with cap No. 106.			
	Fuze, percussion, base, large, bronze, No. 16.			
	Fuze, percussion, direct action, with cap, No. 51.			

† Super charge for use in Mark II howitzer.

§ Except fuzes with cast iron bodies.

¶ Charges for use in Mark II howitzer.

** Charges for use in Mark I howitzer.

CARTRIDGE, B.L. 9·2-INCH HOWITZER, 23-LB. 12-OZ., CORDITE, M.D.T.
OR R.D.B.T., SIZE 20-10.

(Plate XXXI.)

The *Mark I* cartridge consists of a charge of 23-lb. 12-oz. Cordite M.D.T. or R.D.B.T. size 20-10 made up in six sections cut about 13·2-in. long, each contained in a silk cloth or cream serge bag marked "1," "2," "3," "4," "5" and "6" respectively on their top surface for identification purposes.

Section "1" forms a core for the cartridge and consists of 8-lb. 1-oz. of cordite made up in a cylindrical bundle of T section composed of full and half length cordite sticks secured with silk sewing, a ring of quarter length sticks being secured round one end to form the base, to which is fitted an "igniter 9·2-in. F" consisting of two discs of shalloon and one of silk cloth sewn together by rings of stitching and across to form five parallel compartments which are filled with 8-oz. R.F.G.² gunpowder.

Sections "2," "3," "4," "5" and "6" consists of circular bundles containing 2-lb. 2-oz. 8-drs., 2-lb. 11-oz. 8-drs., 3-lb. 5-oz. 4-drs., 3-lb. 15-oz. 12-drs., 3-lb. 8-oz. of cordite respectively and are secured to the core by four ·35-in. silk or shalloon braids.

Maximum diameter . . . 8·25 inches.

Maximum length . . . 31·5 inches.

Earlier supplies of *Mark I* are fitted with "A" igniter.

The *Mark II M.D.T. and R.D.B.T.* cartridges differ from the *Mark I* cartridge in being made from cordite cut 26 inches long, and in the core portion of the No. 1 section consisting of a single cylindrical bundle of full length sticks.

CARTRIDGE, B.L. 9·2-INCH HOWITZER. 26-LB. 15½-OZ. N.C.T.,
SIZE 19, MARK I.

This cartridge consists of a core and five sections, each enclosed in a silk cloth or cream serge bag.

The No. 1 section or core is T-shaped and contains 8-lb. 8-oz. N.C.T. and is fitted at the base with a 9·2 inch. "J" igniter, consisting of two discs of shalloon, and one of silk cloth stitched across to form five parallel compartments which contain 8-oz. R.F.G.² gunpowder.

The base of the core is stabbed through in six places and the stalk in four places with double silk sewing to stiffen the charge. Sections Nos. "2," "3," "4," "5" and "6" contain 2-lb. 9-oz., 3-lb. 1-oz., 4-lb., 4-lb. 13-oz. 8-drs., 4-lb. N.C.T. 19 respectively; they are cylindrical in shape and are attached to the core as follows:—

Sections "2," "3" and "4" butt on to the base and sections "5" and "6" being placed on top of sections "2," "3" and "4," the whole being secured by ·35 silk or shalloon braids passed round the core, round sections and tied with a single bow on the outside of the latter.

In addition, sections "2," "3" and "4" are each stitched in two places to the base of the core.

The mouth of each bag is turned in and closed with double silk sewing No. 20 or single silk sewing No. 1, except in the case of the bag containing the core (No. "1" Section), which is sewn up with double silk sewing No. 1.

A .65 silk or shalloon braid lifting becket is secured to the opposite end to the base.

The sections are marked "1," "2," "3," "4," "5" and "6" and have the words "9.2-inch Mark II howitzer" stencilled on them, in addition to the usual markings.

Length (maximum) .. 30.5 inches.

Diameter (maximum) .. 9.0 inches.

CARTRIDGE, B.L. 9.2-INCH HOWITZER, 10-LB. 14½-oz., CORDITE, M.D.T., SIZE 20-10.

This cartridge consists of a core and three sections each enclosed in a No. 1 class silk cloth or cream serge bag.

The No. 1 section or core is T-shaped in section and contains 6-lb. 0-oz. 12-drs. of cordite; it is fitted at the base with an "Igniter 9.2-inch D," consisting of two discs of shalloon and one of silk cloth, stitched across to form six parallel compartments, which contains 6-oz. R.F.G.² gunpowder.

Sections 2, 3 and 4 contain 1-lb. 9-oz. 14-drs., 1-lb. and 2-lb. 3-oz. 14-drs. cordite respectively, and are attached to the core by .65-in. silk or shalloon braids, which are passed round the stalk of the core and each section, and tied with a bow on the outside, the braids being stitched in one place to the section.

A .65-in. silk or shalloon braid becket is fitted to the end opposite the igniter for lifting purposes.

The sections are marked 1, 2, 3 and 4 respectively on the side for identification purposes, the No. 1 section being also marked on the end opposite the igniter.

Length (maximum) .. 7.75 inches.

Diameter (maximum) .. 9.0 inches.

CARTRIDGE, B.L., 9.2-INCH HOWITZER, 32-LB. 10-oz. N.C.T. 20, MARK I.

Super-charge for Mark II Howitzers.

The cartridge consists of a silk cloth bag filled with N.C.T. and tied in three places with .65-inch silk or shalloon braids.

An igniter is stitched to one end of the bag and consists of two shalloon discs and one silk cloth disc stitched across to form five separate compartments and filled with a minimum of 8-oz. R.F.G.² or S.M.¹ gunpowder. A 1-inch silk or shalloon braid becket is stitched to the opposite end to the igniter for lifting purposes.

The words "Super-charge" are stencilled on the side, in addition to the usual markings.

CARTRIDGE, B.L. 9.2-INCH HOWITZER, 13-LB. 1½-oz., N.C.T. 19.

This cartridge consists of a core and three sections, each enclosed in a No. 1 class silk cloth or cream serge bag.

The No. 1 section or core is T-shaped in section and contains 6-lb., 13-oz. 8-drs. N.C.T. 19, and is fitted at the base with a 9·2-in. "E" igniter, consisting of two discs of shalloon and one of silk cloth stitched across to form six parallel compartments, which contain 6-oz. of R.F.G.² gunpowder. The base of the core is stabbed through in six places and the stalk in two places with doubled silk sewing to stiffen the charge.

Sections "2," "3" and "4" contain 2-lb. 2-oz., 1-lb. 6-oz. 12-drs., 2-lb. 11-oz. 4-drs. N.C.T. 19 respectively, and are each stitched to the core in two places on top and two on bottom, each also are stabbed through in one or two places with doubled silk sewing to stiffen the charge if necessary. Mouth of bags are turned in and closed by sewing with double silk sewing No. 20, or single silk sewing No. 1.

Two ·65-in. silk or shalloon braids are stitched to the core, and tied on stop of the cartridge to form a lifting band.

The Sections are marked 1, 2, 3 and 4 respectively on the side for identification purposes, the No. 1 section being also marked on the end opposite the igniter.

Length (maximum) .. 8·05 inches.

Diameter (maximum) .. 9·4 inches.

CARTRIDGE, B.L. 9·2-INCH HOWITZER, 11-LB. 13-oz. CORDITE, M.D.
OR R.D.B., SIZE 12, MARK I.

(Plate XXXII.)

This cartridge consists of a core and three sections each enclosed in a No. 1 class silk cloth or cream serge bag.

The No. 1 section or core is T-shaped in section and contains 7-lb. 1-oz. 8-drs. of cordite; it is fitted at the base with a 9·2-in. "D" igniter consisting of two discs of shalloon and one of silk cloth stitched across to form six parallel compartments, which contain 6-oz. R.F.G.² gunpowder.

Sections "2," "3" and "4" contain 1-lb. 9-oz. 2-drs., 1-lb. 0-oz. 9-drs., 2-lb. 1-oz. 13-drs. cordite respectively, and are attached to the core by ·65-in. silk or shalloon braids, which are passed round the stalk of the core and each section, and tied with a bow on the outside, the braids being stitched in one place to the section. Mouth of bags are turned in and closed by sewing with double silk sewing No. 20, or single silk sewing No. 1.

A ·65-in. silk or shalloon braid becket is fitted to the opposite end to the igniter for lifting purposes.

The sections are marked 1, 2, 3 and 4 respectively on the side for identification purposes, the No. 1 section being also marked on the opposite end to the igniter.

Length (maximum) .. 7·75 inches.

Diameter (maximum) .. 9·0 inches.

CARTRIDGE, B.L. 9·2-INCH HOWITZER, 30-LB. 5-oz. CORDITE, M.D.
OR R.D.B., SIZE 15, MARK I (SUPERCHARGE).

This cartridge consists of a charge of 30-lb. 5-oz. cordite M.D. or R.D.B., size 15, contained in a silk cloth bag.

The charge is made up in a cylindrical bundle, cut about 17.25-in. long and tied in four places with .35-in. silk webbing.

A 9.2-in. "A" igniter, which is stitched to one end of the bag, consists of two discs of shalloon and one of silk cloth sewn together by rings of stitching and across to form five parallel compartments which are filled with 8-oz. R.F.G.² gunpowder.

A silk or shalloon braid becket is stitched to the opposite end of the bag for lifting purposes.

Maximum diameter ..	8.5-inches.
Maximum length ..	18.2 inches.

SHELL, B.L., HIGH EXPLOSIVE, 9.2-INCH HOWITZER.

(Plate XXXIII.)

The *Mark XIV A* shell is made of forged steel, with parallel walls, the base being closed with a full bore flat topped adapter. It has a four-calibre radius head, which is fitted with a metal or mild steel 2-in. fuze-hole bush suitable for the use of an exploder container, or alternatively, the fuze-hole is formed in the head of the shell proper.

The shell is fitted with a new narrow driving band, which is plain except for a slope at the front and rear, the front portion of the band being serrated. The driving band groove has four waved ribs turned in it to prevent the band from turning on the shell.

Shell fitted with this design of band have two longitudinal black stripes 1-in. in width painted on opposite sides, from the driving band to the shoulder, to distinguish them from shell having the old pattern band.

The *Mark XV A* shell differs from the *Mark XIV A* in being fitted with a broad copper driving band having two cannelures and a serrated front slope.

The *Mark XVI A* shells differs from the *Mark XV A* in having a tapered cavity and a solid base fitted with a steel plate disc.

The *Mark XVII A* shell differs from the *Mark XVI A* in being fitted with a driving band as is the *Mark XIV A* shell.

The *Mark XVIII* shell differs from the *Mark XV A* in having a two calibre radius head and thinner walls.

The *Mark XIX* shell differs from the *Mark XVIII* in having thinner walls and a solid base fitted with a steel plate disc.

The *Marks XIV A* to *XVII A* shell are *not* suitable, for the *Mark I* 9.2-inch howitzer.

SHELL, B.L., COMMON POINTED, 9.2-INCH HOWITZER.

The *Mark I A* shell is made of steel and has a pointed head struck with a radius of four calibres. It has parallel walls and the base is closed with a full bore, cup-shaped adapter, which is recessed and screwed to receive the No. 16 base fuze, gascheck plate and perforated base cover plate, the latter being secured by a fixing screw in the bottom of the adapter.

An undercut groove is turned near the base of the shell to receive a broad copper driving band having two cannelures and the front slope serrated. Seven wave dribs are formed in the groove to prevent the band from turning on the shell.

The external diameter of the shell body may be slightly reduced between a band formed at the shoulder and one above the driving band.

SHELL, B.L., CHEMICAL, 9·2-INCH HOWITZER.

The *Mark I A* chemical shell is the *Mark XVI A* high explosive shell converted.

The numeral of the H.E. shell stamped on the base is barred out and replaced by the numeral of the chemical shell.

The body of the shell is painted light grey, and coloured bands are painted round the middle of the body to distinguish the charging.

PROJECTILE, PRACTICE, B.L., 9·2-INCH HOWITZER.

(Plate XXXIV.)

The *Mark II* practice projectile is made of iron with parallel walls. It has a two-calibre radiused head fitted with a metal nose bush screwed to the G.S. fuze-hole gauge, and the driving band is similar to that described for the *Mark XV A* high explosive shell.

The projectile weighs 290 lbs. filled and fuzed, and contains a bursting charge of 20 lb. 13½ oz. of L.G. powder.

FUZES.

Instructions relating to the Care of No. 106 and 106E Fuzes.

(1) The (safety) cap of the No. 106 and 106E fuzes must be removed, and the wire seal broken *only* immediately prior to firing.

(2) If a No. 106 or 106E fuze has become uncapped in any manner except that referred to in (1), or has the wire seal inadvertently broken, it is to be regarded as unfit for firing, and is to be withdrawn from use.

(3) Fuzes withdrawn under paragraph (2) are to be examined to ascertain if the brass tape under the hammer head is present and correct; if this is so, the (safety) cap should be replaced and secured in position by a becket and the fuze returned to the Ordnance store for transmission to Woolwich. If examination shows that the brass tape is incorrect, or missing, the fuze may be in a *dangerous condition*, and must be destroyed under expert supervision.

In securing the (safety) cap with the becket, difficulty may arise with fuzes, where the body is not provided with an eye through which the becket may be threaded, in such cases, wooden pegs should be driven in the fixing key holes in the body and the becket fastened round these.

(4) It is essential that the becket should be fastened in such a manner, so as to prevent the cap coming off in transit to Woolwich. The method of fastening the fuze-cap is as shown on Plate XL.

FUZE, PERCUSSION, D.A. No. 51.

(Plate XXXV.)

These fuzes are No. 44 fuzes cut down to a length of 1.4 inches and filled with powder, for use in powder-filled shell for practice.

The *Mark III* fuze consists of the following principal parts, made of metal unless otherwise stated: body, detonator holder and plug, copper needle disc with steel needle, screwed collar, shutter with spring and screw, base plug, steel safety cap with securing and safety pins.

The body is screwed below the head to the G.S. gauge; it is bored out from the head to receive the shutter, detonator holder and needle disc, the latter being secured by a screwed collar. The bottom of the fuze is bored out to form a magazine and is closed by a screwed plug with a central fire hole. A central fire hole is bored in the diaphragm formed between the magazine and the shutter, leaving a slight thickness of metal at the top under the shutter to mask the hole.

The shutter is flat, and is provided with a spring which holds it back until the spinning of the shell brings a fire hole in the shutter over the fire hole in the diaphragm of the fuze body.

A charge of F.G. powder is inserted in the magazine and a 5-grain detonator in the detonator plug.

The safety cap has a projecting milled edge and two bayonet joint slots in the side to engage with pins on the head of the fuze. Two holes are drilled through the top of the cap into the fuze, one for the securing pin and the other for the safety pin; the two pins are looped together and held in position by a length of whipcord tied to them and round the cap. The securing pin is painted red, and a red stripe is painted on the side of the cap to indicate the position of the hole in the fuze body.

The pins must be withdrawn before loading by a straight pull vertically.

Action.—The rotation of the shell at about 1,200 revolutions per minute causes the shutter to swing outwards and bring the flash hole over the flash hole in the fuze body. On impact the needle is driven on to the detonator, the flash from which passes through the fire holes in the shutter and fuze body to the charge in the magazine, the flash of which fires the bursting charge in the shell.

The *Mark II* fuze differs from the *Mark III* in having a different form of safety cap, made of steel, tinned, nickel or copper plated; the length of whipcord is omitted, two securing pins being provided which have double prongs; they are connected with each other by a loop of copper wire, and the safety pin has a whipcord becket attached to it.

The *Mark I* fuze differs from the *Mark II* in having a different form of holder, screwed collar and shutter.

FUZE, TIME, No. 188M.

(Plate XXXVI.)

This fuze is converted from Fuze T and P, Nos. 83 or 88. The *Mark V* fuze consists of the following parts, which are made of metal

unless otherwise stated: body, top and bottom time rings, cap, base plug; needle and spring of steel with detonator pellet for the time arrangement; and wood block.

The cap and base plug may alternatively be made of steel.

The lower part of the body is screwed to suit the 2-inch fuze hole gauge; above this is a platform and stem to receive the time rings; the top of the stem of smaller diameter is screwed externally to receive the cap, which is slotted to receive the key No. 48, or a screw driver for clamping purposes. A chamber bored out from the top of the stem contains the time-lighting arrangement, and the base of the body is bored out to form a chamber which is fitted with a wood block (in place of the percussion arrangement of the Nos. 83 and 88 fuzes): below this the body is bored out to form a magazine containing a perforated powder pellet, and is closed with a base plug; a channel is bored from the magazine communicating with the bottom time ring. The fuze is graduated from 0 to 22 in tenths.

A double-pointed needle is screwed into the diaphragm between the time-lighting chamber and the lower chamber. The top ring is secured to the body by two brass pins; the bottom ring is provided with a lug for setting purposes.

The time arrangement consists of the upper needle with a steel spiral creep spring, above which is the pellet holding the detonator; a flash hole communicates with the top time ring.

The top ring has a channel bored out and filled with No. 83 fuze composition, and the bottom ring with R.D. 202 composition; a flash hole is bored between the two rings, and both rings have gas-escape holes which are covered with asbestos and brass discs shellaced in.

The flash holes are filled with perforated powder pellets and the channel leading to the magazine with loose powder.

A leather washer is fitted to the body below the flange.

Action.—On shock of discharge the time detonator pellet sets back on to the needle and ignites the composition in the top ring; this burns round and communicates by the flash hole with the bottom ring, which burns the reverse way and fires the composition in the channel leading to the magazine, the flash of which passes into the shell.

The fuze is marked as follows:—

Red band round lower part of cap, denoting magazine filled with powder pellets. Lower time ring lacquered red, denoting that it is filled with R.D. 202 composition. Blue "T" on side, denoting that the percussion arrangement has been omitted.

The fuze is fitted with a rubber cover and packed one in a cylinder.

Key No. 18 is used for setting, and No. 17 for fixing purposes.

Mean time of burning set full, after correcting for barometer, 48 seconds.

The *Mark IV* fuze differs from the *Mark V* in having the time arrangement in a chamber at the side of the body instead of being in the centre; a separate needle on a broad base piece is inserted in the bottom of the chamber.

The flash holes are also modified. The percussion needle of the fuze from which this is converted is inserted from the top of the stem, and is left in position.

The *Mark III* fuze differs from the *Mark IV* in having a smaller chamber for the time arrangement, the needle being lighter. The cap and base plug are not made of steel.

The *Mark III** fuze is a *Mark III* fuze with the time arrangement modified, and the chamber and flash holes enlarged to approximate to *Mark IV*.

The *Marks I and II* fuzes differ mainly from the *Mark III* in having a stirrup spring instead of a spiral one to hold the detonator pellet off the needle; a safety-pin with lanyard is also inserted horizontally below the pellet for the same purpose, which is removed prior to the shell being inserted in the gun.

FUZE, PERCUSSION, No. 101B.

(Plates XXXVII to XXXIX.)

The *Mark II* fuze consists of the following principal parts: Body, cap, graze pellet, detonator plug, detonator, needle, creep spring, paper cylinder, centrifugal bolt, detent, detent spring, safety shutter and adapter.

The *body* is made of metal, it is screwed externally at the base to the 2-inch fuze-hole gauge, the upper part being conical in shape and fitted with a cap which is screwed in. It is bored out from the head to receive the graze pellet, below this chamber a fire channel is bored leading to the shutter recess.

A second chamber is bored parallel to the fire channel to receive the detent and its spring and is closed at the base by a screwed plug. Across the upper part a hole is bored at right angles to receive the centrifugal bolt and is closed by a screwed plug.

Around the body are two knurled bands, the upper one painted black denotes that no cocked pellet is fitted as in the No. 100 fuze, the lower one red, to distinguish it from the No. 101B fuze, which has stronger detent and shutter springs.

Two slots are made to receive a key for fixing purposes.

A lip is formed on the flange for the purpose of punch stabbing the fuze into the shell.

The body is bored out from the base and screwed to receive an adapter.

The *cap* is screwed externally at the base to fit the body and recessed to receive the head of the creep spring, it is bored out from the head, recessed and screwed to receive a steel needle.

The *graze pellet* is cylindrical and is screwed internally at the base to receive the detonator plug. The head is stepped to form seatings for the centrifugal bolt and creep spring.

The *detonator plug* forms a support for the detonator.

The *detonator* consists of a copper cup containing 1.7 grains of fulminate composition with brass discs at top and bottom and closed by a copper or glazeboard washer, the whole being held in the cup by the edge of the latter being spun over it.

The *creep spring* is inserted between the underside of the cap and the head of the graze pellet, it holds the detonator off the needle during flight.

The *centrifugal bolt* is fitted into the chamber at the side of the body which is closed by a screwed plug. The inner end fits over a shoulder in the top of the graze pellet.

The *detent* consists of a body and pin connected by a ball and socket joint, the pin passes up behind the centrifugal bolt and is kept in position by a spiral spring, the chamber is closed at the base by a screwed plug and at the top by a sealing ball of brass or copper, which is inserted after inspection of the empty fuze.

A *paper cylinder* lined with tinned plate is inserted in the fire channel between the graze pellet and the shutter.

The *adapter* is screwed externally at the head to fit the fuze and internally to receive the gaine, a recess is bored out across the head to receive the shutter. The adapter is secured into the fuze and the gaine into the adapter by a set screw.

The *safety shutter* consists of a rectangular plate slotted at the inner end to receive the stem of a detent, at the outer end is a spiral spring to keep it in position.

The shutter is fitted into a recess in the head of the adapter and covered with a tinned plate cap with a flash hole in the centre, a metal disc being inserted below the shutter with a similar flash hole in it. The shutter opens when the shell is spun at between 1,500–2,000 revolutions per minute.

"J" or "K" adapters which have modified forms of cap and are fitted with shutters opening when the shell is spun at between 1,300–1,700 revolutions per minute may also be fitted. In which case the letters "J" or "K" will be added to the Mark.

Action.—On shock of discharge the detent sets back compressing its spring and freeing the centrifugal bolt, the latter on the rotation of the shell flies outwards and unlocks the graze pellet.

On acceleration decreasing after the projectile has left the bore the shutter is also moved outwards by the centrifugal force compressing its spring, in moving it releases its detent which drops down and keeps the shutter clear of the flash holes.

During flight the graze pellet is prevented from moving by the creep spring, but on impact it moves forward carrying the detonator on to the needle. The flash from the detonator passes through the fire channel to the gaine which detonates the bursting charge.

FUZE, PERCUSSION, WITH CAP. No. 106E.

(Plate XLI.)

The Mark IV fuze consists of the following principal parts:— Body, cap, hammer, steel collar in halves, brass tape with weight, steel and dermatine washers, copper shearing wire, steel guide pin, detonator holder, detonator, magazine with shutter, shutter spring, bottom screwed cap, shalloon and paper discs.

The *body*, which is made of bronze, is screw-threaded externally at its lower end to suit the 2-inch fuze-hole gauge. Its upper end, which is generally conical in shape, terminates in a cylindrical stem, which is screw-threaded to receive the cap. Slots are cut in the body to receive the No. 53 key for fixing purposes. The body is further prepared to receive a shearing wire, guide pin and a countersunk hole to take the wire securing the cap. A groove is cut round the shoulder for punch stabbing the fuze to the shell when fuzing the latter.

Internally the body is bored out in different diameters to receive the hammer, detonator holder and magazine.

The *hammer* is of steel, fitted with an aluminium head. The lower end is pointed to form a needle. Just below the head a recess is bored to take a stud on one-half of the steel collar and in one side a slot is cut through which fits the shearing wire and guide pin. The hammer is placed in position from the top of the fuze body, passing through a steel washer on the top of the latter. The guide pin is screwed into the body, one end entering the slot in the hammer. The shearing wire passes through the body and hammer, the ends being afterwards turned over. The function of the guide pin is to prevent the hammer turning whilst the tape is being wound or unwound, while the shearing wire keeps the hammer clear of the detonator after the collar has become detached, until the shell strikes. Around the hammer under the head and resting on the steel washer of the body, is a steel collar in halves, one-half of which has a pin to fit the recess in the hammer and around this again is wound a brass tape to one end of which is soldered a weight. The top of the fuze is then closed by a \cap -shaped steel or malleable cast-iron cap, which screws on to the projection at the top of the body against a dermatine washer, and is held in position by a steel wire which passes through an eye in the cap, the two ends being twisted, a complete turn is then taken round the cap and the loose ends inserted in the hole provided in the body and fixed therein by a lead plug pressed in.

The *steel collar* and tape prevent the hammer moving on to the detonator until they have been freed by the rotation of the shell during flight, and so prevent any possibility of a premature in the bore or near the muzzle.

The *detonator holder* is held in position by the top surface of the magazine. Its upper end is recessed to receive the detonator, which is held in position by the mouth of the holder being spun over. A cupro-nickel or brass disc is placed on top of the detonator. An opening is bored through the centre of the holder, which is filled with

loose "composition, exploding," the opening being closed by a paper disc shellaced to the bottom of the holder.

The *magazine* is screwed externally to suit the interior of the body, and is reduced in diameter near the bottom and screwed to receive the bottom cap. The top of the magazine is recessed and fitted with a shutter and spring which swings open when the fuze is spun during flight. The bottom of the magazine is bored out to contain a compressed C.E. pellet and is closed by the bottom cap.

A set screw is screwed into a hole in the body of the fuze, and holds the magazine in position.

Preparation of Fuze.—To prepare the fuze the wire is broken, and the cap unscrewed and removed at the moment of loading.

Action.—On de-acceleration after leaving the bore the rotation of the shell causes the weight on the tape to fly outwards causing the latter to become unwound from the steel collar; the latter in turn drops off, leaving the hammer supported only by the shearing wire.

The rotation of the shell during flight causes the shutter to swing outwards until a hole formed in it comes into line with the central perforation in the detonator holder and on impact the hammer is driven in, breaking the shearing wire and piercing the detonator. The flash from the detonator ignites the loose "composition, exploding," in the detonator holder, which in turn detonates the magazine, and from thence the flash passes to the bursting charge in the shell.

The *Mark IV's* fuze differs from the *Mark IV*, in the head of the hammer being made of steel, instead of aluminium.

FUZE, PERCUSSION, No. 106.

(Plates XLII and XLIII.)

This fuze is generally similar to the No. 106E described above, from which it differs principally in not having a removable magazine with safety shutter.

FUZE, PERCUSSION, BASE, LARGE, BRONZE, No. 16.

(Plate XLIV.)

The *Mark IV* fuze consists of the following parts:—Body, detonator pellet, pressure plate, screwed cap, protecting ring, centrifugal bolt, three springs, pea ball, small retaining bolt, locking pellet, steel needle, detonator plug, set screw for cap, retaining bolt for pea ball, screwed pin and four closing plugs.

The *body*, which is of aluminium bronze, is turned and screwed on the exterior to suit the fuze hole in the shell; the interior is bored out to form a chamber for the percussion arrangement and screwed at the top to take the cap, while the bottom of the chamber is coned and recessed to suit the detonator pellet. A hole is bored through the side of the body to receive the small end of the centrifugal bolt and closed by a screwed plug. A hole is also bored through the opposite side of the body to receive the small retaining bolt, and is closed by a screwed plug. A third hole is bored at an angle of 45 degrees to the first hole and screwed to receive the screwed pin for the detonator

pellet. Further holes are bored, one to receive the retaining bolt for pea ball, and two others longitudinally, one for the channel which contains five powder pellets and the other for the pressure plate; a flash hole is also bored from the powder pellet channel to the percussion chamber. The top of the body has a circular recess for a compressed powder ring and two elongated holes are cut in the base for use with the Key No. 8 when screwing the fuze into the shell.

The interior of the *detonator pellet* is bored out and screwed at the top to receive the detonator plug and detonator and a flash hole is bored through. A hole is bored at right angles to the axis for the centrifugal bolt, locking pellet and small retaining bolt. The exterior of the pellet at the top is recessed to form a seating for the creep spring, and is tapered in order that on impact the pellet will be driven into the coned seating in the screwed cap and thus assist the locking pellet in preventing the detonator pellet from being blown back, and masking the flash hole in the fuze body. The bottom is reduced in diameter, forming a cone and stem to suit the interior of the percussion chamber and is provided with a circular flange which fits into a groove in the body and seals the flash hole from the detonator until the pellet moves forward on graze. A slot in the pellet engaging with a pin screwed into the body prevents the pellet turning in flight.

The *detonator* contains about three grains of composition, and is secured in the detonator pellet by means of a screwed detonator plug.

The *pressure plate* is of copper, it is cupped and has a lip round the edge to form a gascheck and is held in position by the steel protecting ring which is screwed into the recess in the base below the pressure plate and secured by punch stabs. Near the top the spindle of the plate is reduced in diameter to enter the slot in the small retaining bolt when in flight.

The *screwed cap* has a curved top and the lower part is reduced in diameter and threaded externally to suit the percussion chamber. The centre of the cap is threaded to take a steel screwed needle and six fire holes are bored through the flange; the cap is secured in the body by a set screw.

The *centrifugal bolt* is fitted with a brass pin which engages in a hole in the detonator pellet and prevents the bolt turning, thus ensuring that the flash hole in the stem of the bolt is always in correct alignment with the flash hole in the pellet.

The *small retaining bolt* prevents any movement of the centrifugal bolt except when in flight.

The *pea ball* seals the flash hole communicating with the channel in the body containing the powder pellets and is held in position by its retaining bolt with spring until the rotation of the shell during flight causes the bolt to move outwards.

The *locking pellet*, on impact, locks the detonator pellet in the forward position, it being forced into the recess for the centrifugal bolt in the body through the action of its spring.

The fuze requires no preparation before loading.

The approximate weight of the fuze is 2 lb. 10 ozs.

The fuzes are issued one in a tin cylinder, 50 in a "Case wood packing."

Action.—On discharge, the gas pressure crushes in the pressure plate, carrying forward the spindle, thus bringing the reduced diameter of the spindle opposite the small retaining bolt. The rotation of the shell causes the bolt to move outwards; the slot in the small retaining bolt fitting round the reduced part of the spindle allows the centrifugal bolt to withdraw its projecting end from the recess in the body and to bring its vertical flash hole in line with the fire channel in the pellet. At the same time the retaining bolt in the base of the fuze, acted upon by centrifugal force, moves outwards, compressing its spiral spring, thus allowing the pea ball to move out of its seating and open the fire channel in the base.

On graze or impact, the detonator pellet moves forward, overcoming the spring and carrying its detonator on to the needle, at the same time withdrawing the flange round its base from the groove in the bottom of the percussion chamber.

The locking bolt, engaging with the recess in the body, retains the pellet in the forward position and thus allows the flash from the detonator to pass down through the channel in the centrifugal bolt and pellet through the hole left open by the pea ball to the powder pellets in the vertical channel, thus firing the magazine in the front end of the fuze, the flash from which, passing through the six fire holes in the cap, explodes the bursting charge of the shell.

ADAPTER, 2-INCH FUZE HOLE, No. 12.

This adapter is made of steel or metal and is for use with No. 188M, fuze and No. 2 gaine in H.E. shell.

The exterior is screwed for a certain distance to the 2-inch fuze hole gauge, below which it is turned plain. A hole is bored out from the bottom and screwed to receive a No. 2 gaine and a groove is cut across the top to accommodate a shutter, which is retained in position by a perforated tinned steel cap soldered to the top of the adapter.

GAINE, No. 2.

(Plate XXXVII.)

The gaine, which acts as an exploder to the shell, is made of steel, and consists of a hollow cylinder containing explosive, the cylinder being screwed externally at one end to suit the adapter No. 12 for the 101 or 101 E and 188 M fuzes with which it is used. The screwed end of the cylinder is closed with a shellaced disc, and the opposite end with a screwed plug, or cap.

FUZE, DRILL.

The drill fuzes resemble generally the service fuzes which they represent and in some cases burnt-out service fuzes are used for this purpose.

To facilitate identification, the drill fuzes are blackened externally and stamped "Drill."

TUBES.

TUBES, FRICTION, T.

(Plate XLV.)

The tube consists of the following principal parts: Body, head, copper ball, plug and friction bar.

The head is of gunmetal, the body of solid drawn brass, the ball of soft copper, and the friction bar of half-round copper wire, twisted into a round bar, with a loop at one end and the other end roughened. A hole in the side of the head of the tube over the friction bar is charged with grains of detonating composition* in the form of a paste laid over the roughened part of the friction bar, the hole being closed with a screwed brass plug or waterproof composition. The body is charged with 8 grains of pistol powder and is closed with a cork plug, covered with shellac cement, and a paper disc. The end of the body is spun over to secure the cork plug.

A brass pin is inserted to prevent the body becoming unscrewed. The upper part of the body has a central perforation, which is enlarged in its lower part into a conical recess. The copper ball is placed in this recess and is retained therein by a screwed plug pierced by three fire holes.

On the withdrawal of the friction bar the detonating composition is ignited and the flash, passing down the perforation in the head and through the plug, fires the powder charge. The ball is driven back by the explosion and seals the tube. This, together with the mode in which the tube is held in the vent, prevents the escape of gas.

The body is lacquered inside and outside.

Total length of tubes, 1.9 inches.

The tubes are issued in square tin boxes, ten in a box. Both the top and the bottom of the box are removable, being secured by soldered bands, and the tubes are so arranged that five may be withdrawn from the top and five from the bottom.

TUBE, PERCUSSION, T.

(Plate XLVI.)

The body of this tube is similar to the friction tube described above, but has a percussion firing arrangement in the head instead of a friction bar.

The firing arrangement consists of a steel needle or striker with spring, secured by a shearing wire in an eyepiece. A detonator is inserted in the opposite end of the head which is closed by a screwed plug.

To fire the tube a lanyard is hooked in the eyepiece and a steady pull given to compress the spring, with a final jerk to shear the wire passing through striker and eyepiece, thus releasing the striker which is forced forward by the spring and fires the detonator, the flash from which passes to the powder in the body similarly to the T friction tubes.

* The detonating composition will in future be replaced by friction tube composition.

The packing of these tubes is the same as for the T friction tubes but the boxes have an orange coloured label to distinguish them.

NOTES.

In the event of a tube failing to ignite a charge, care should be taken in extracting the fired tube, not to stand directly in rear of the howitzer, as the gas generated will cause the tube to fly out with some violence so soon as the T-head is clear.

The "lever extracting and inserting T-tube" is for use in removing or inserting a tube after a missfire has occurred.

The vent channel sometimes becomes choked with residue from the cartridge. When this occurs the taper portion should be cleared with a "Rimer, vent, T," sufficiently to allow of the insertion of a tube, which, when fired, will remove the rest of the obstruction.

TUBE, FRICTION AND PERCUSSION, T, DRILL, MARK I.

The drill tube is made of hardened steel, of the same external shape as the service tube. The head of the tube is grooved to receive a hardened steel spring, which is arranged for a pull of about 50 lb.

TUBE, FRICTION AND PERCUSSION, T, DRILL, CONVERTED, MARKS I AND II.

These are fired service T-tubes fitted with a steel spring clip, which is adjusted for a pull equal to that required for the service tube.

These tubes will supersede the "Tube, friction, T, drill, Mark I," when existing stock is used up.

TUBE, PERCUSSION, S.A. CARTRIDGE, MARK I.

(Plate XLVII.)

This tube is used with guns or howitzers having rifle firing mechanism. The form and general dimensions are shown on Plate XL. It consists of the following parts:—Body with cap and cork disc.

The body and cap consists of the .303 rifle cartridge case filled with a charge of 30 grains, S.M.1 powder. It is closed at its front end with a cork disc or suberit, which is covered with shellac varnish before insertion and the exposed side afterwards waterproofed with shellac.

IMPLEMENTS, AMMUNITION.

Key, No. 5 (Mark III).—The key is for use in inserting and removing G.S. fuze-hole plugs and D.A. impact fuzes of high explosive shell, the projection provided on the side of the key being used in the square recess of the safety cap of the fuze.

In cases, however, where greater leverage is required in removing fuzes, the projection on the smaller radius of the key may be used by being inserted into the "T"-shaped slot of the safety cap, the cap having previously been turned so that the projection on the key may bear against the side of the slot and not against the pin in the head of the fuze. By this means the strain will be distributed between the pins on the head instead of entirely coming on one only, which would be the case if the key were used direct against the pin. The securing pins of the fuze must previously be removed.

*Key, No. 8 (Marks II** III* and IV).*—The No. 8 key is used with large and medium base plugs and fuzes. It consists of a steel bar about 18 inches in length, circular in section, except at the centre where it is rectangular, and in the centre of the bar and on three sides of it are two projections which are made to fit the slots in the large and medium base percussion fuzes respectively. The other side of the bar is formed with a square projection which is made to fit the recess in the large and medium base plugs.

Key No. 17.—The key is used for fixing the No. 80 type of fuzes and 188 M fuze.

The *Mark II* key is made of steel, one end being shaped to fit over the fuze; the lower edge of the ring portion is bevelled to suit all Marks of fuzes without covers and is provided with a projection to fit the square notch in the flange of the fuze body. The upper edge of the ring is provided with a slot to fit over the projection on the cover when screwing in fuzes with cover.

The *Mark I* key differs from the *Mark II* in the upper edge not being prepared for use with fuzes with cover.

Total length of key 6.91 inches.

Key No. 18.—The key is used for setting the No. 80 type of fuzes and 188 M fuze.

The *Mark I* key is for use when the lower time ring is too stiff to set by hand. It is made of steel and formed to engage with the pin projection of the lower time ring. It is provided with a loop of white line, 30 inches in length.

The *Mark II* key differs from the *Mark I* in the ring portion being of greater depth, thereby taking a better seating on the fuze.

The *Mark III* key differs from the *Mark II* in having two slots in the handle in order to assist in the removal of the tin plate cover of the fuzes, the end of the tear-off strip being passed through the slots.

The *Mark IV* key differs from the *Mark III* in being pressed from mild steel sheet instead of being forged.

Total length of key 6.17 inches.

Key No. 48, Mark I.—The key is made of a plain bar of steel 10 inches long, .75-inch wide and .14-inch thick.

It is used for inserting or removing fuze-hole plugs having suitable slots.

Key No. 53—2-inch Percussion or Graze Fuzes.—This key is for use in lieu of the No. 16 key with 2-inch percussion or graze fuzes and for “Adapter, 2 inch fuze hole, No. 2.”

Each end is semi-circular in shape with the inner edge chamfered and a projection formed to engage in the slot provided for the purpose.

Key No. 59.—This key is for use in removing G.S. and G.S. special fuze-hole plugs, also 2-inch fuze-hole plugs, except 2-inch No. 3, Marks IV and V, and No. 8.

It is made of steel. It is double-handed and consists of a 15-inch round bar passing through a centre portion, having a circular base recessed to fit over the plugs; a projecting rib, formed across the centre of the recess, engages in the key slots on the top of the plugs.

A slightly tapered square projection is formed on the top of the centre portion for use with plugs having square recesses.

LIST OF STORES ISSUED AS PART OF THE B.L. 9·2-INCH HOWITZER EQUIPMENT.

Apparatus, securing recuperator ram (for use when dismounting howitzer)	..	..	..	..	1
†Bearer, loading tray	..	..	..	..	1
†Bearer, projectile	..	..	..	..	1
Connectors, engine draught, No. 2	..	..	..	..	5
Gauge, pressure, No. 5	..	..	..	..	1
Guides, bed	..	..	..	..	4
Jacks, lifting screw, with ratchet lever	..	..	..	..	2
Levers, ratchet, raising screw	..	..	..	..	3
Pieces, ramping	..	..	..	(set)	1
Screws, raising—long, with nut	..	..	..	..	3
„ „ —short, with nut	..	..	..	..	2
Spanners and special implements	..	..	..	(set)	1
Trays, loading	..	..	..	..	3

SIDE ARMS, &c.

The following side arms, &c., are required for use with these howitzers, viz. :

- Bit, vent, 18-inch.
- Cleaner, piasaba, No. 16.
- Cover, breech, B.L. 9·2-inch Mark I howitzer.
- Cover, breech, B.L., 9·2-inch Mark II howitzer.
- Cover, canvas, air pump.
- Cover, muzzle, No. 6 (a).
- Cover, muzzle, No. 21 (b).
- Cover, recuperator ram, B.L., 9·2-inch Mark I howitzer.
- Cover, recuperator ram, B.L., 9·2-inch Mark II howitzer.
- Cover, rocking bar sight, No. 1.
- Drifts, No. 11 (a).
- Drifts, No. 12 (b).
- Extractor, cartridge, B.L., 10-inch to 7·5-inch Mark I.
- Lanyard, firing, No. 23 (c).
- Lanyard, firing, No. 33 (d).
- Lever, extracting and inserting T tube, B.L., 12-inch Mark II, and 9·2-inch howitzers.
- Rammer and sponge, B.L., 9·2-inch Mark I howitzer.
- Rimer, vent, T.
- Rimer, vent axial, ·303-inch chamber No. 2.
- Stave, end, No. 53 (Mark I).
- Stave, intermediate, B.L., 9·2-inch howitzer, No. 1 (a).
- Staves, intermediate, B.L., 9·2-inch Mark II howitzer, No. 2 (b).
- (a) For Mark I equipment only.
- (b) For Mark II equipment only.
- (c) For use with T tubes.
- (d) For use with P.H. percussion lock.

† Will be replaced by "lifter, projectile" when existing stocks have been used up.

PUNISHMENT CENTER

BOX, STORES, B.L. 9-2-INCH HOWITZER, MARK I, SIEGE EQUIPMENT, No. 1.

(Tools, Service at Gun.)

		Bit, vent ... 1 Brush, breech screw ... 1 Brush, water, carriage ... 1
Spanner, adjustable ... 1 Pincers, carpenters ... 1		Hammer, claw, 32-oz. ... 1
Can, lubricating, No. 9 ... 1	Pliers, side cutting ... 1 Lanyard, firing ... 2 Handle, file, small ... 1 File, safe edge, 8-inch ... 1	Wrench, breech mechanism, No. 103 ... 1 Wrench, breech mechanism, No. 104 ... 1 Wrench, breech mechanism, No. 105 ... 1
Lever, extracting tubes ... Screwdriver, G.S., 6-inch	... 2 ... 1	Rimers, vent, T ... 2 Pocket, gunlayers ... 1 Drift, No. 11 ... 1 File, half round, 8-inch ... 1 Holder, file, half round, 8-inch... 1

BOX, STORES, B.L. 9-2-INCH HOWITZER, MARK II, SIEGE EQUIPMENT, No. 1.

(Tools, Service at Gun.)

		Bit, vent ...	...	1	
		Brush, breech screw ...	...	1	
		Brush, water, carriage ...	...	1	
		Hammer, claw, 32-oz. ...			
Spanner, adjustable ...	...	1			
	Pincers, carpenters ...	1			
Can, lubricating, No. 9 ...	1				
	Pliers, side cutting ...	1			
	Lanyard, firing ...	2			
	Handle, file, small ...	1			
	File, safe edge, 8-inch ...	1			
Lever, extracting tubes ...	...			
	Screwdriver, G.S., 6-inch ...	2			
	...	1			
			
			
		Rimers, vent, T ...	...	2	
		Pocket, gunlayers ...	...	1	
		Drift, No. 12 ...	...	1	
		File, half-round, 8-inch ...	...	1	
		Holder, file, half round, 8-inch ...	...	1	
		Wrench, breech mechanism, No. 165 ...	...	1	
		Wrench, breech mechanism, No. 166 ...	...	1	
		Wrench, breech mechanism, No. 167 ...	...	1	
		Wrench, breech mechanism, No. 169 ...	...	1	

Box, STORES, B.L. 9.2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENT No. 2.

(Drawing Instruments, &c.)

Body of box.

Tape, rubber, in tins. Solution, rubber, 1-lb. Cells electric, dry. Lamp, telegraph, mechanics.	Batteries, dry, torch.
	Batteries, dry, "O" 6-cell.
	Batteries, dry, torch.

Tray.

Torches, electric.	Celluloid, sheets, 18-inch by 18-inch.			
	Battery, dry, torch.	Pencils. Pins, drawing.	Instruments, drawing, in case.	Compass, prismatic, in leather case.
		Tape, measur- ing, 100-ft. Protractor, 9-inch circular.		Galvano- meter, in leather case.
		Protractor, semi-circular 8-inch special.		
Compass, magnetic, plane table.	Lamps, electric, torch.	Rules, sight, 16-inch, in case.		

Box, STORES, B.L. 9·2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENT No. 3.

(Indirect Laying Stores.)

Can, oil, armouers. Oil for instruments.	Mekometers, H. & F. Plotter, field. Telemeter, artillery.	
Clinometers, large, in cases. Reels and cords for mekometers. Leather, chamois.	Sight, dial, No. 7.	Sight, dial, No. 7.
Director, No. 2.		Director, No. 2.

Box, STORES, B.L. 9·2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENT, No. 4.

(Brake blocks.)

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Box, Stores, B.L. 9-2-INCH HOWITZER, MARK I, SIEGE EQUIPMENT No. 5.
(Spare Parts of Carriage.)

Leather packing rings and washers, in tin box. Plugs, air, control chamber. Plugs, air, filling and drain. Plunger, locking, stuffing box, hydraulic buffer. Rings, air pump, high pressure. Ring, low pressure. Rod, eccentric, air pump. Spindle, valve, recuperator. Valve, air pump, suction. Valve, air pump, delivery.		
Pieces, ramping, for strut.		
Spare spiral springs. Screws, lubricating hole.	Screws, fixing, $\frac{3}{8}$ ". Screws, fixing, $\frac{3}{8}$ ".	Springs, disc, brake gear.
Bolts, holding down bedplate.		
Nut, bolt securing.	Screws, fixing carriage body.	
Bush, control chamber. Caps, dust. Pieces, ramping (packing). Plunger, locking, gland and stuffing box, recuperator.		

Articles.	No.
Caps, dust, 1st class "B" capped wheels	2
Carriage, siege, B.L., 9·2-inch howitzer—	
Bolts, holding down bedplate to beam	2
Bush control cylinder, hydraulic buffer	1
Gear, elevating—	
Plate, clutch	1
Plate, stop, worm wheel	1
Nuts and bolts, securing body to bedplate	2
Plugs, air, filling and drain, hydraulic buffer	2
Plugs, retarding, hydraulic buffer	1
Plungers, locking—	
Gland and stuffing box, recuperator	1
Gland, hydraulic buffer	1
Pump, air, two-stage—	
Rings, piston, high pressure	2
" " low-pressure	1
Rod, eccentric	1
Springs, valve, large	1
" " small	3
Valves, large	2
" small	6
Rings, packing—	
Buffer, hydraulic—	
Rubber, cup-shaped, stuffing box	2
" L-section, inner gland	2
Recuperator—	
Cup shape, floating piston	2
Leather, U-section large	4
" " medium	4
" " small	4
Screws, cover—	
Bracket, bevel wheel, elevating and traversing	2
Bracket, worm-shaft traversing, centre	1
" " " left	1
Case, gear elevating, left	1
Case, gear loading, 1·15-inch long	2
" " " " " "	1
Gear, quick loading	3
Springs—	
Bolt, travelling lock pivot block	1
Brake gear (disc No. 53)	12
Hydraulic buffer and recuperator—	
Plunger, locking gland and stuffing box	1
Plunger, locking gland	1
Spiral, rod actuating loading gear	1
Tank, hydraulic buffer—	
Plugs	1
Valves, air release	1
Springs	1
Washers, leather	2
Washers, plug, vulcanised fibre	2

Box, STORES, B.L., 9·2-INCH HOWITZER, MARK II, SIEGE EQUIPMENT,
No. 5.—Continued.

Articles.	No.
Washers, packing—	
Hydraulic buffer—	
Leather control cylinder	2
„ plugs, air, filling and drain	10
„ plug, retarding	2
Recuperator—	
Leather, box, stuffing	2
„ plugs, air, filling and drain	6
Copper, rear plug for gauge connection	2
Klingerit, rear plug, joint	2
Levers, ratchet, screw raising, B.L., 9·2-inch howitzer equipment—	
Spring, catch pin	3
Pieces, ramping, B.L., 9·2-inch howitzer (set)	1
Screws, lubricating hole, thumb, $\frac{1}{16}$ -inch \times $\frac{3}{8}$ -inch	6
Wagon, transporting, B.L., 9·2-inch howitzer—	
Screws, cover—	
Case, bevel wheel and pinion raising gear	2

FOR THE RECORD

Box, Stores, B.L. 9-2-INCH HOWITZER, MARKS I AND II, SIEGE EQUIPMENT No. (Spart Parts of Carriage.)	
Rings, leather, dust excluder.	Links, chain, cranked and straight :— Driving and Hauling. Rings, split, 1-inch diameter. Rings, split, $\frac{3}{4}$ -inch diameter.
<p>Eyes, withdrawing holdfast. Measures, filling, hydraulic buffer Pins, linch. Washers, drag. Funnel, filling, cylinder, No. 3.</p>	
Gauges, pressure.	
Collars, adjusting, capped wheels.	Adapters for gauges, pressure. (To be kept packed in tow and paper.) Rope, wire.

Box, Stores, B.L. 9-2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENTS No. 7.

(Miscellaneous.)

Body of Box.

<p>Lantern, magazine. Chalk, white, in box.</p>	<p>Cloths, sponge. Driver, grummet. Flannelette. Hammer, hide faced. Handles, for pit saw. Line, hambro. Line, white, 1-lb. skein. Pipe, connecting, pressure gauge. Pocket, tube, with strap. Spun-yarn, 3-thread. Twine, packing, middling. Twine, whipping. Keys, No. 5 (fuze). " " 48. " " 53.</p>	<p>Packings, compressed, { Hydraulic buffer. Recuperator. Dick's material.</p>
	<p>Saw, hand, in leather case. Saw, tenon, 14-inch.</p>	<p>Gauges, shell.</p>

Tray.

Screwdriver, G.S., 9-inch.	
Hammer, riveting, 24-oz. Scissors, lamp.	
Line, carpenters, on reel.	Marline spike.
Key, M.L. powder case	Chisel, ripping.
Wedge, sawyers, 10-inch.	Wedge, sawyers, 7-inch.
Nail puller.	

Box, STORES, B.L. 9-2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENTS No. 8.

(Lubricants, &c.)

Potash. Sal-ammoniac. Stone, rag. Stone, rub scythe. Tallow, in box.	Boxes, dubbing or mineral jelly, 2-lb.	Borax. Soap.	Grease, lubricating, or mineral jelly, in cylinders, paint.	Grease, lubricating, or mineral jelly, in cylinders, paint.
	Oil, lubricating, G.S.			Oil, olive.

Box, STORES, B.L. 9-2-INCH HOWITZER, MARKS I AND II,
SIEGE EQUIPMENTS No. 9.

(Screws, Raising.)

Long	3
Short	2

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Body of box.

Spanner, No. 189	...	1	Spanner B.L. 9-2-inch, No. 2	...	1
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Spanner, B.L. 9-2-inch, No. 27	1		Spanner, B.L. 9-2-inch, No. 13...		1

Levers, ratchet, screw, raising ... 3

Plug, adapting, $\frac{7}{8}$ -inch spanner ... 1

Tray.

Spanner, B.L. 9-2-inch, No. 16	...	1	Tommy, small	...	1	Spanner, B.L. 9-2-inch, No. 14...	1
Spanner, B.L. 9-2-inch, No. 11	1	Spanner, B.L. 9-2-inch, No. 4	...	1	
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Spanner, B.L. 9-2-inch, No. 9	...	1	Spanner, B.L. 9-2-inch, No. 17	...	1	Spanner, B.L. 9-2-inch, No. 10	...

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(Spanners and ratchet levers.)

Body of box.

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Spanner, B.L. 9-2-inch, No. 27	...	1	Spanner, B.L. 9-2-inch, No. 13	...	1
Spanner, B.L. 9-2-inch, No. 23	...	1			
Spanner, B.L. 9-2-inch, No. 24	...	1			
Spanner, B.L. 9-2-inch, No. 25	...	1			
Plug, adapting, $\frac{3}{8}$ -inch spanner	...	1			
			Levers, ratchet, screw, raising	...	3

Tray.

Spanner, B.L. 9-2-inch, No. 16	...	1	Tommy, small	...	1	Spanner, B.L. 9-2-inch, No. 14	...	1	
Spanner, B.L. 9-2-inch, No. 11	...	...	1	Spanner, B.L. 9-2-inch, No. 4	...	1		
Tools, repairing, endless chain { Driving.									
Tools, repairing, endless chain { Hauling.									
Tommy, No. 26 spanner	1	Spanner, B.L. 9-2-inch, No. 12		1	Spanner, B.L. 9-2-inch, No. 8	...	1
Spanner, B.L. 9-2-inch, No. 9	...	1	Spanner, B.L. 9-2-inch, No. 17	...	1	Spanner, B.L. 9-2-inch, No. 10	...	1	

Box, STORES, B.L. 9·2-INCH HOWITZER, MARK I, SIEGE EQUIPMENT, No. II.	
(Rocking-bar sight, spares, spanners, &c.)	
Article.	No.
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Carriers, No. 7 dial sight, No. 4	2
Sight, rocking bar, B.L. 9·2-in. howitzer, Mk. I & II, siege Carriage	
Spring, drift (flat)	1*
" retaining range dial reader	1
" disc, carrier axis bolt and deflection pivot ... pairs	2
" disc, range pinion	1
" catch, bolt telescope bearing	2
Spanners, No. 2	1
" No. 4	1
" No. 5	1
Screwdrivers, adjusting sights	1

* For mark I and Ia sights only.

Box, STORES, B.L. 9·2-INCH HOWITZER, MARK II, SIEGE EQUIPMENT, No. II.	
(Rocking-bar sight, spares, spanners, &c.)	
Articles.	No.
Bubble, spirit glass P	1
Sight, rocking bar, B.L. 9·2-in. howitzer Mark II siege Carriage (assembled)	1
Carriers, No. 7 dial sight, No. 4	2
Sight, rocking bar, B.L. 9·2-in. howitzer, Mk. I & II siege Carriage	
Spring, drift (flat)	1*
" retaining dial sight reader	1
" disc, carrier axis bolt and deflection pivot ... pairs	2
" disc, range pinion	1
" catch, bolt telescope bearing	2
Spanners, No. 2	1
" No. 4	1
" No. 5	1
Screwdrivers, adjusting sights	1

* For Mark I and Ia sights only.

Box, STORES, B.L. 9·2-INCH HOWITZER, MARK I. SIEGE EQUIPMENT, No. 12.							
(Spare parts of breech mechanism.)							
Articles.							No.
Ordnance, B.L. 9·2-inch howitzer, Mark I—							
Bearings, ball	...	...	...	...	...	...	1
Shaft, actuating	...	...	...	...	...	...	1
Springs—							
Catch, retaining breech screw open and breech mechanism lever closed	...	...	...	...	...	...	2
Latch, retaining breech screw open	...	...	...	...	...	...	2
Retaining, T tube	...	...	...	...	...	...	2
Vent, T axial	...	...	...	...	...	...	2
Vent, T axial	...	...	...	...	...	...	1

Box, STORES, B.L. 9·2-INCH HOWITZER, MARK II, SIEGE EQUIPMENT, No. 12.							
(Spare parts of breech mechanism.)							
Articles.							No.
Ordnance, B.L. 9·2-inch howitzer, Mark II							1
Bearings, ball...	...	...	...	...	...	...	1
Cage, roller bearing	...	...	...	...	...	...	1
Crosshead	...	...	...	...	...	...	1
Pin, axis, roller breech screw	...	...	...	...	...	...	1
Plates, catch, breech mechanism lever	...	...	...	...	...	...	1
Plates, retaining, breech screw	...	...	...	...	...	...	1
Rollers, breech screw	...	...	...	...	...	...	1
Sleeve, carrier hinge joint	...	...	...	...	...	...	1
Springs—							
Catch, breech mechanism lever	...	...	...	...	...	...	2
Retaining T-tube No. 1	...	...	...	...	...	...	2
Vent, axial	...	...	...	...	...	...	2
Vent, T-axial	...	...	...	...	...	...	1

Box, STORES, B.L. 9·2-INCH HOWITZER, MARK II. SIEGE EQUIPMENT, No. 13.									
(Spare parts of breech mechanism.)									
Articles.									No.
Ordnance, B.L. 9·2-inch howitzer, Mark II—									
Carrier, complete	1
Lubricator, No. 1	1
Rollers, for roller bearing	12
Screw, breech...	1

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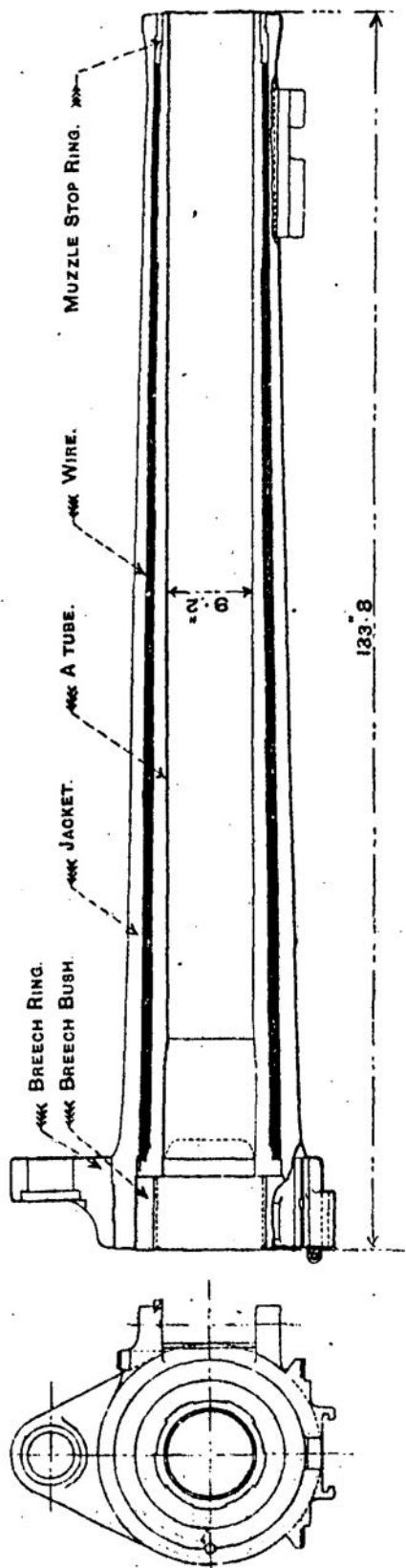
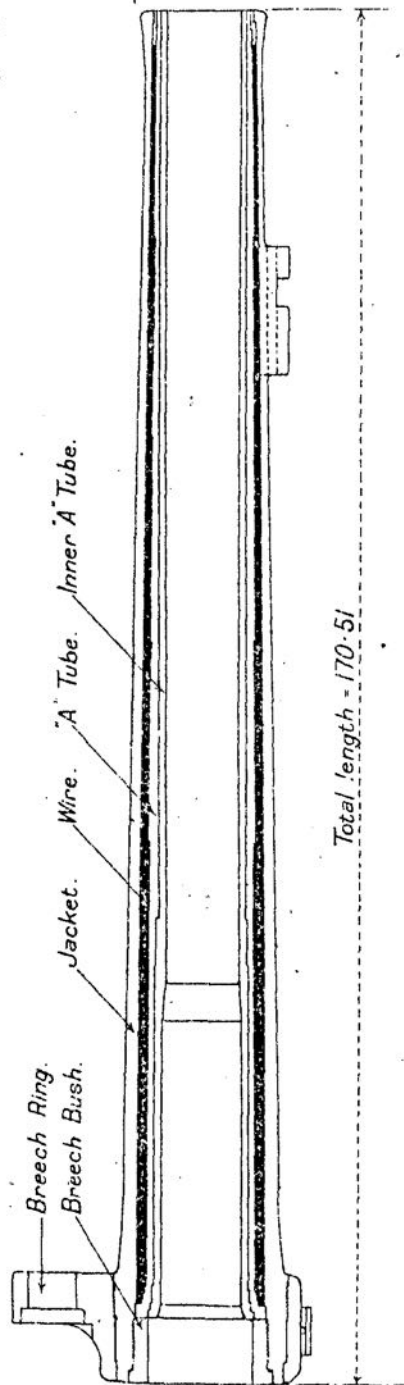


Plate I.

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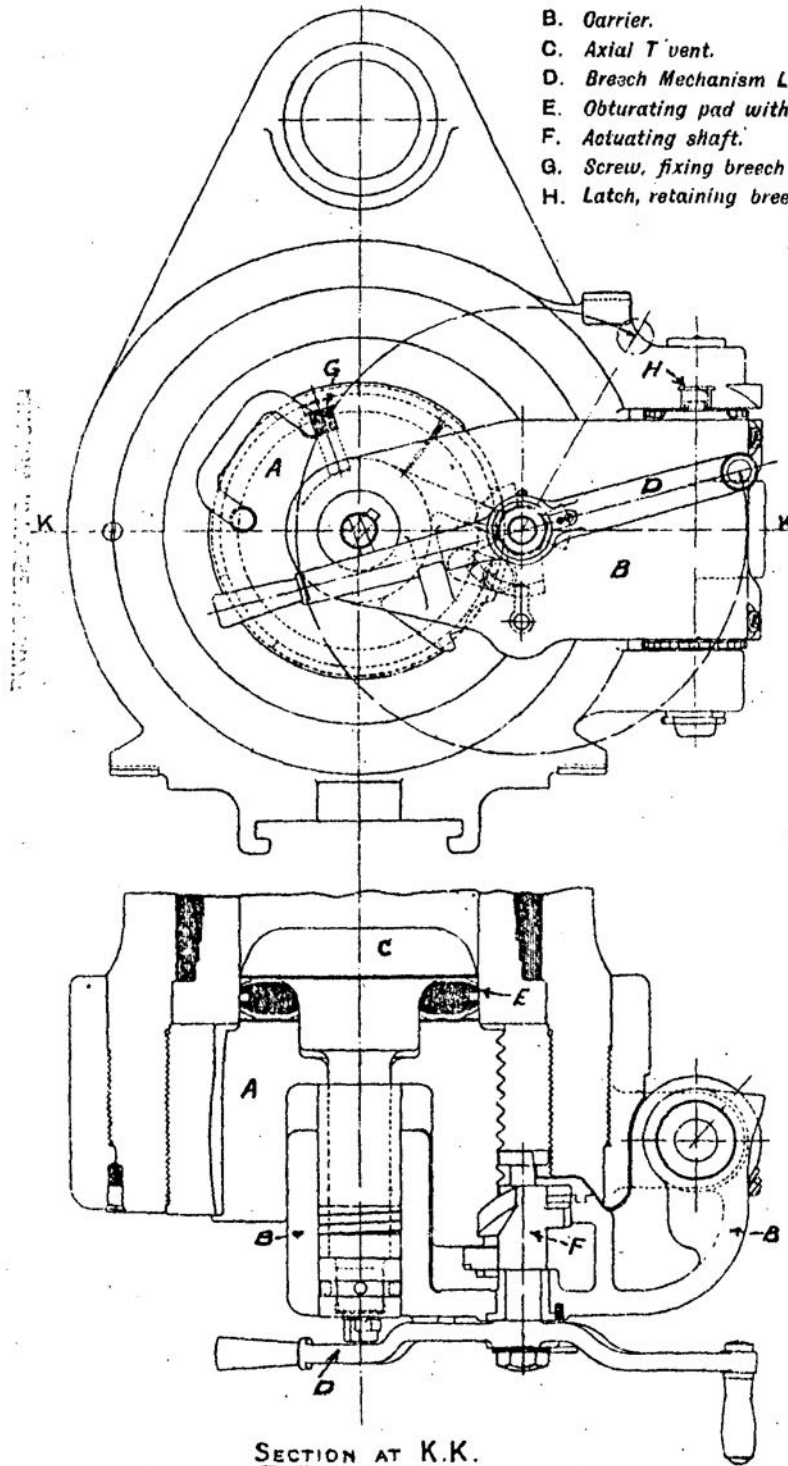
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ORDNANCE, B.L. 9.2-INCH HOWITZER, MARK I.
GENERAL ARRANGEMENT OF BREECH MECHANISM WITH AXIAL T VENT.

— SCALE $\frac{1}{8}$. —

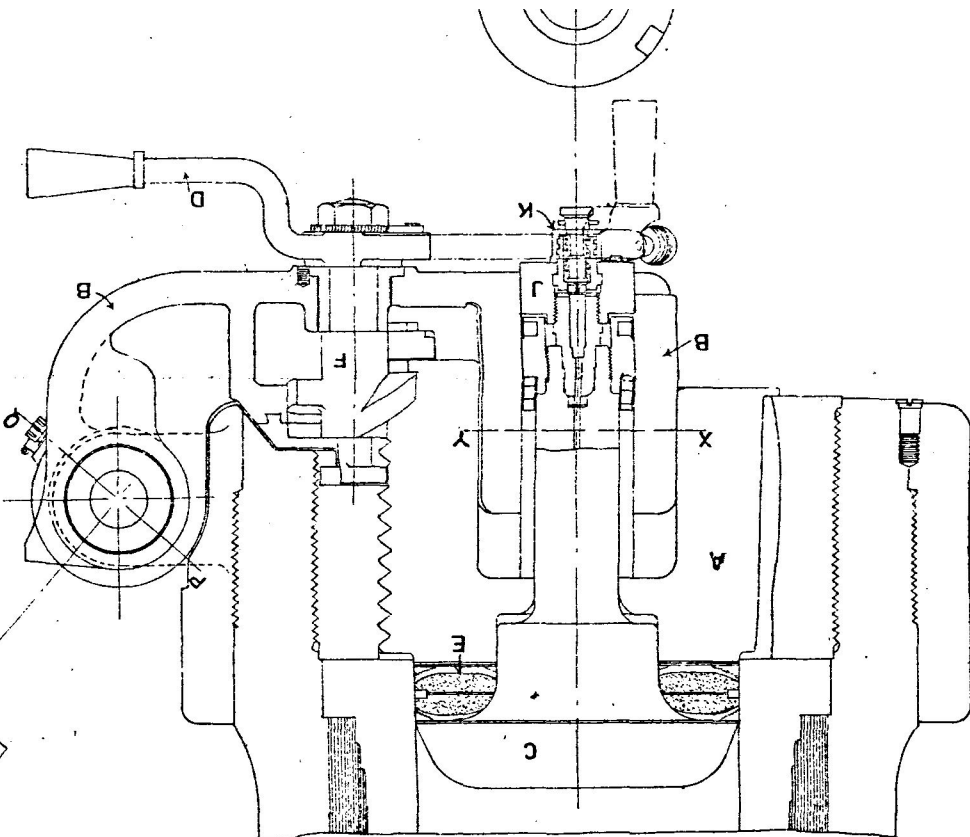
- A. Breech Screw.
- B. Carrier.
- C. Axial T vent.
- D. Breech Mechanism Lever.
- E. Obturating pad with centre ring.
- F. Actuating shaft.
- G. Screw, fixing breech screw.
- H. Latch, retaining breech mechanism open.



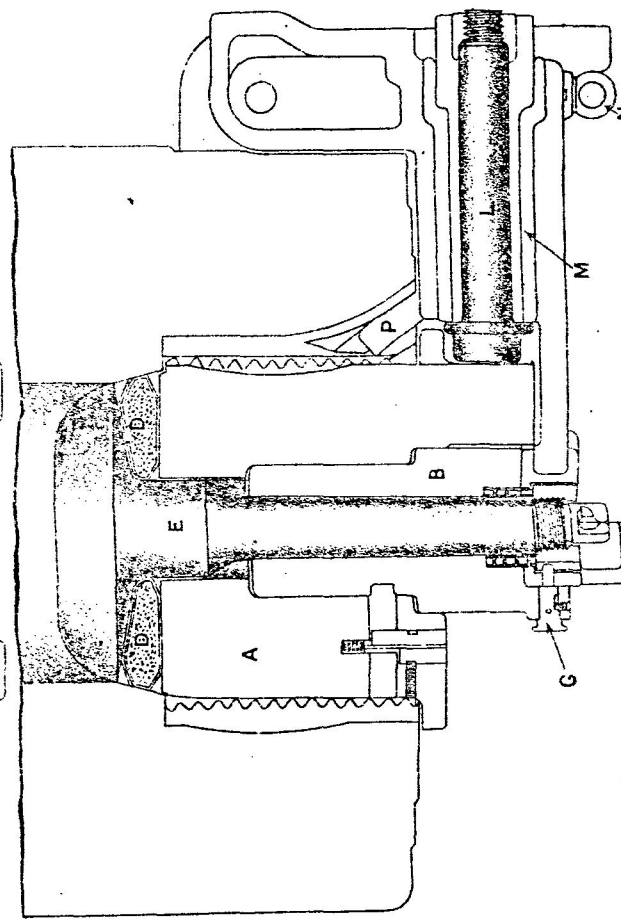
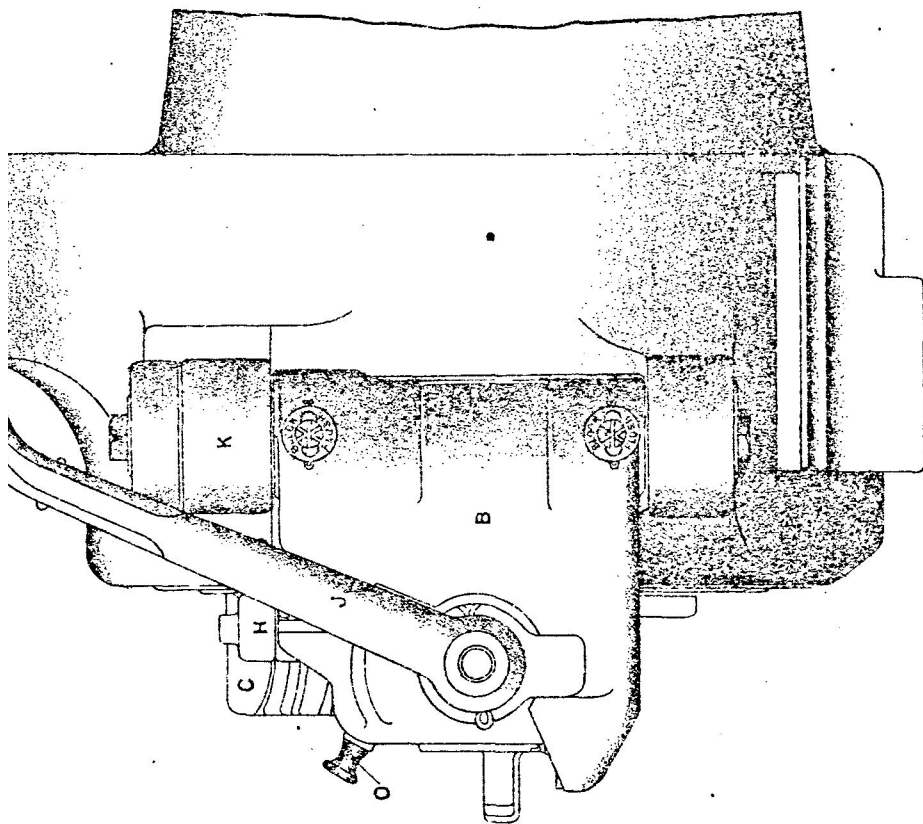
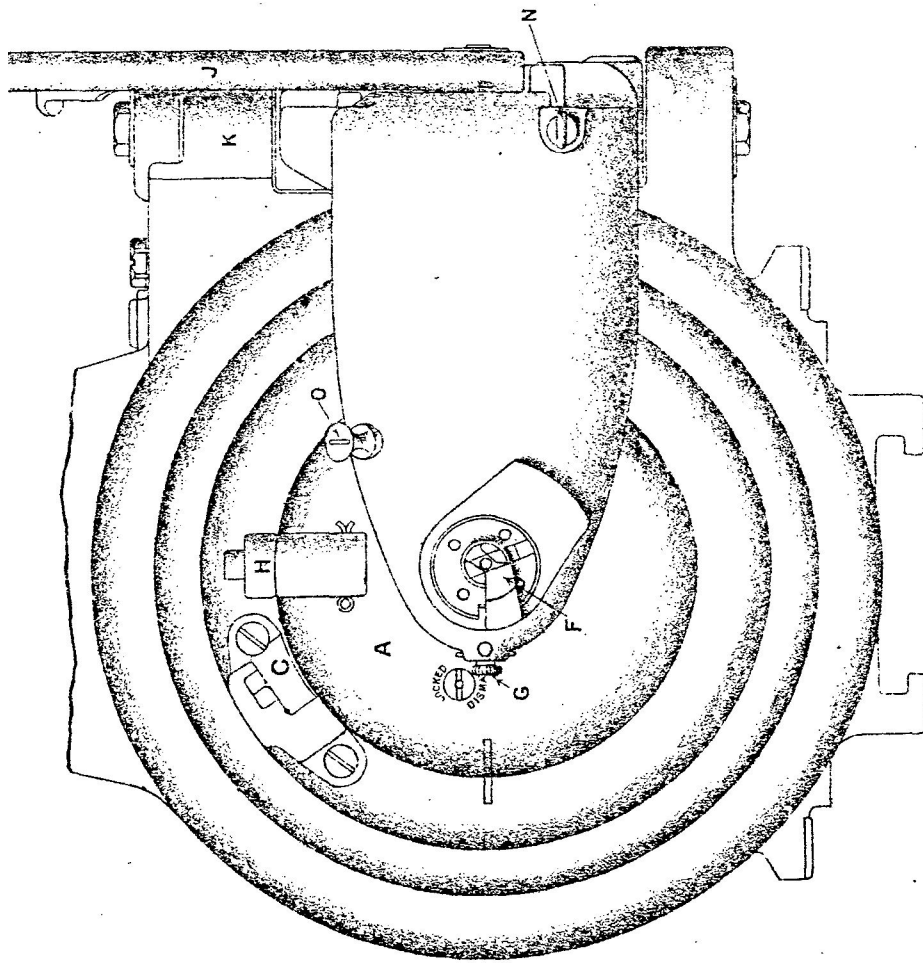
SECTION AT K.K.

GENERAL ARRANGEMENT OF BREACH MECHANISM WITH
BOX, SLIDE, "V" & LOCK PERCUSSION, "P. H."

Swing of mechanism - 35°



K. Lock, percussion, P.H.

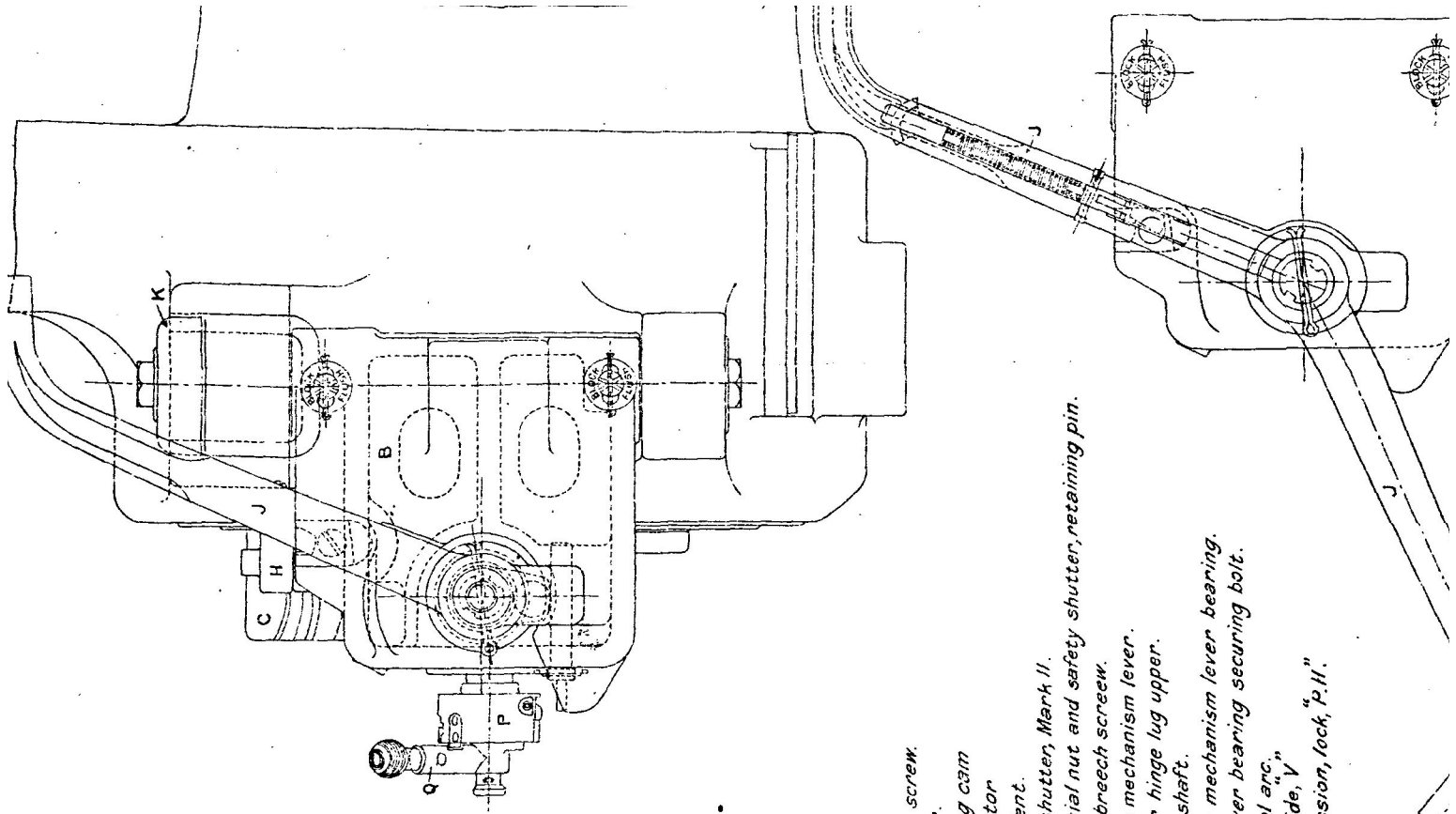


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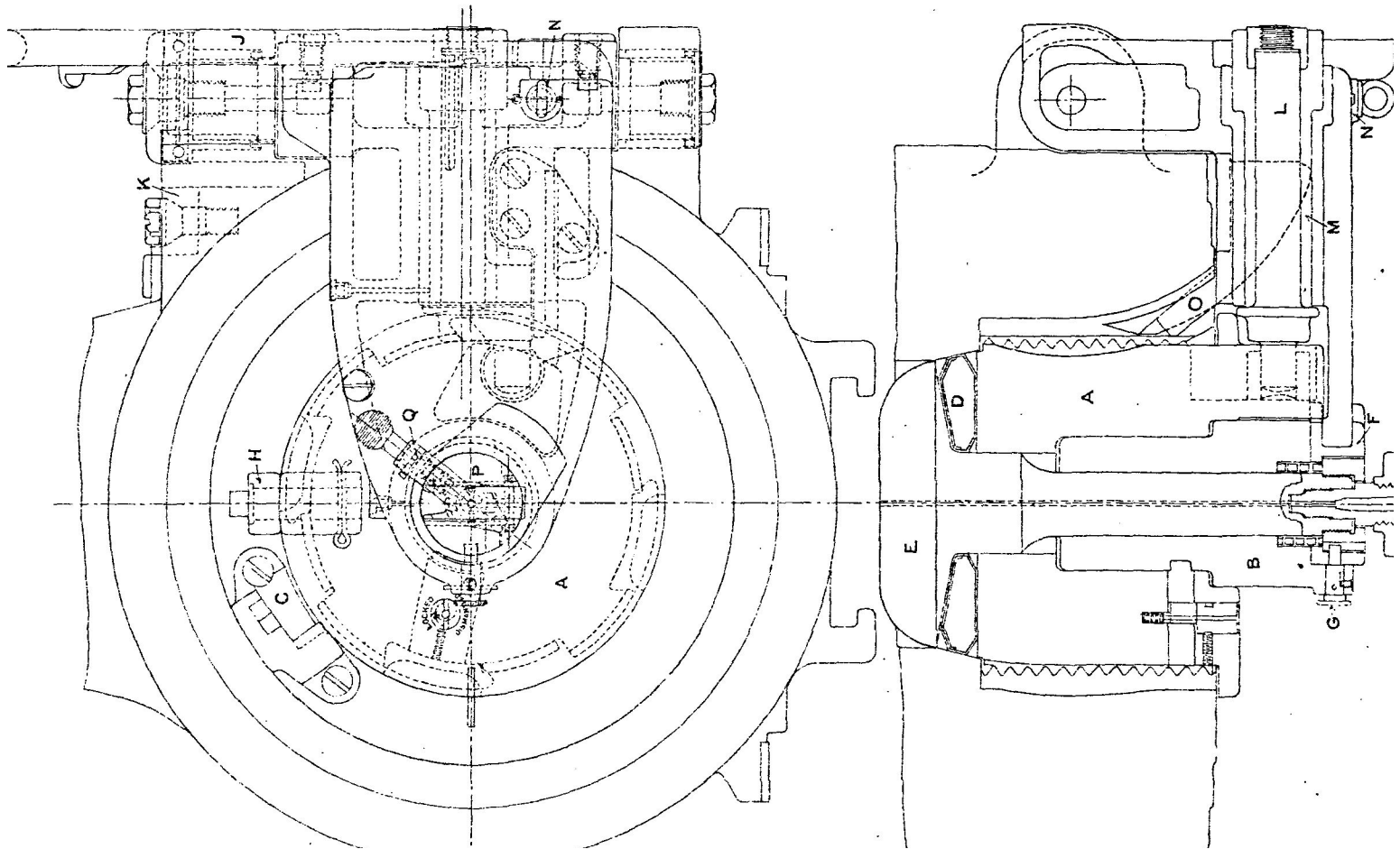
GENERAL ARRANGEMENT OF BREECH MECHANISM, WITH AXIAL T VENT.

- A. Breech screw.
- B. Carrier.
- C. Rotating cam.
- D. Obturator.
- E. Axial T Vent.
- F. Safety shutter.
- G. Vent axial nut and safety shutter retaining pin.

- H. Roller, Breech screw.
- J. Breech mechanism lever.
- K. Carrier, Hinge lug, upper.
- L. Crank shaft.
- M. Breech mechanism lever bearing.
- N. B.M. lever bearing securing bolt.
- O. Firing lanyard fairlead stud.
- P. Control arc.



- A. Breech screw.
- B. Carrier.
- C. Rotating cam
- D. Obturator
- E. Axial Vent.
- F. Safety shutter, Mark II.
- G. Vent axial nut and safety shutter, retaining pin.
- H. Roller, breech screw.
- J. Breech mechanism lever.
- K. Carrier hinge lug upper.
- L. Crank shaft.
- M. Breech mechanism lever bearing.
- N. B.M. lever bearing securing bolt.
- O. Control arc.
- P. Box slide, V
- Q. Percussion, lock, "P.H."

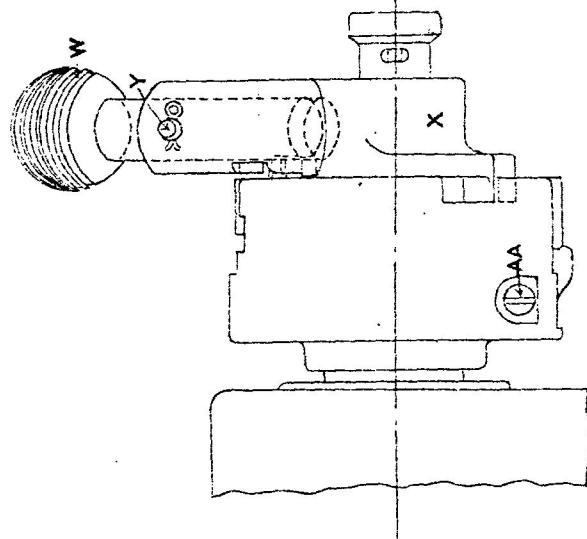


ORDNANCE, B.L. 9·2-INCH HOWITZER, MARK II.

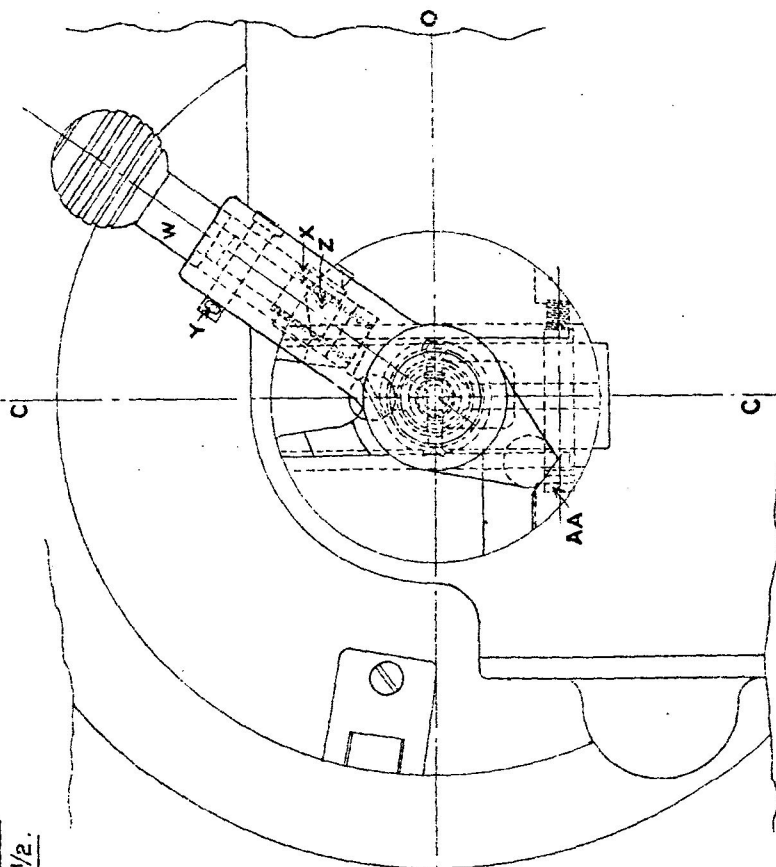
General arrangement of firing mechanism with Lock, Percussion, "P.H." & Box, slide, "V."

TYPICAL.

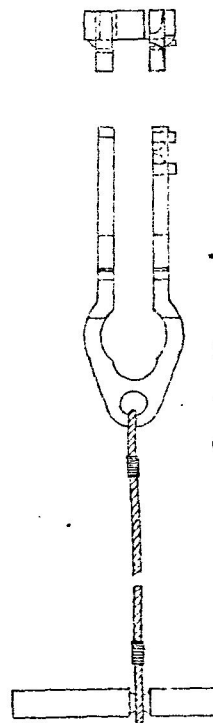
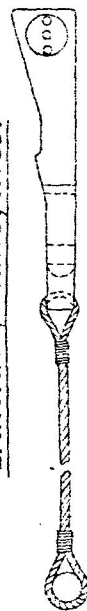
Scale 1/2.



- W.....Retaining catch plunger.
- X.....Lock actuating lever.
- Y.....Retaining catch guide pin.
- Z....." " spring.
- AA.....Extractor axis screw.
- BB.....Firing hole bush.



LANYARD, FIRING, No 93.

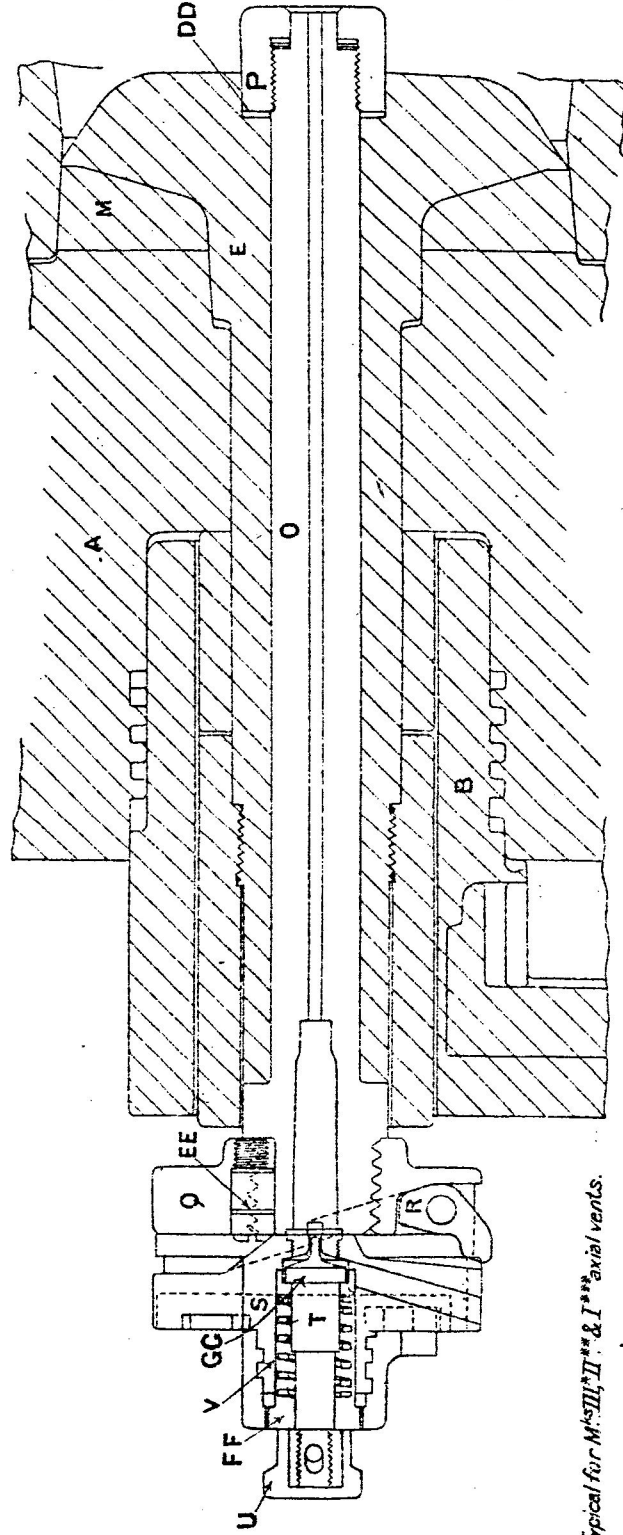


ORDNANCE, B.L. 9.2-INCH, HOWITZER, MARK II.

General arrangement of firing mechanism with lock, percussion, "P.H." and Box, slide, "V."

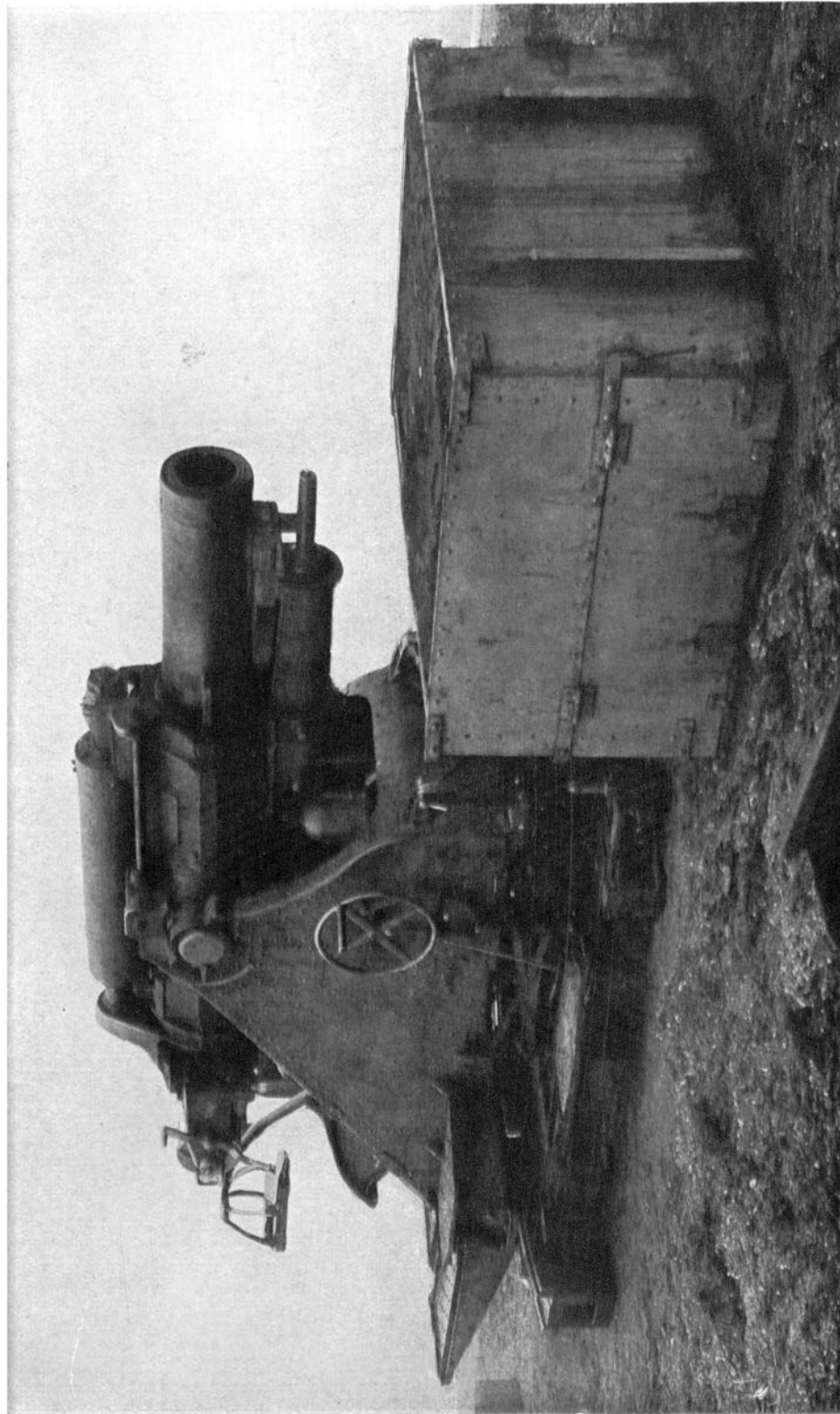
TYPICAL.

Scale 1/2.



SECTION AT C.C. (see plate VII)

- A. Breech screw.
- B. Carrier.
- E. Vent axial, mark-III, II, I & I^{***} axial vents.
- M. Obturator.
- O. Vent bush spindle.
- P. Nut, vent bush spindle.
- V. Box, slide "V."
- R. Extractor lever.
- S. Lock, percussion, "P.H."
- T. Striker.
- U. Striker cap.
- V. Main Spring.
- DD. Washer, vent bush spindle.
- EE. Securing screw, box slide "V"
- FF. Striker collar.



B.L. 9.2-INCH HOWITZER IN LOADING POSITION. (FRONT VIEW, SHOWING EARTH BOX.)

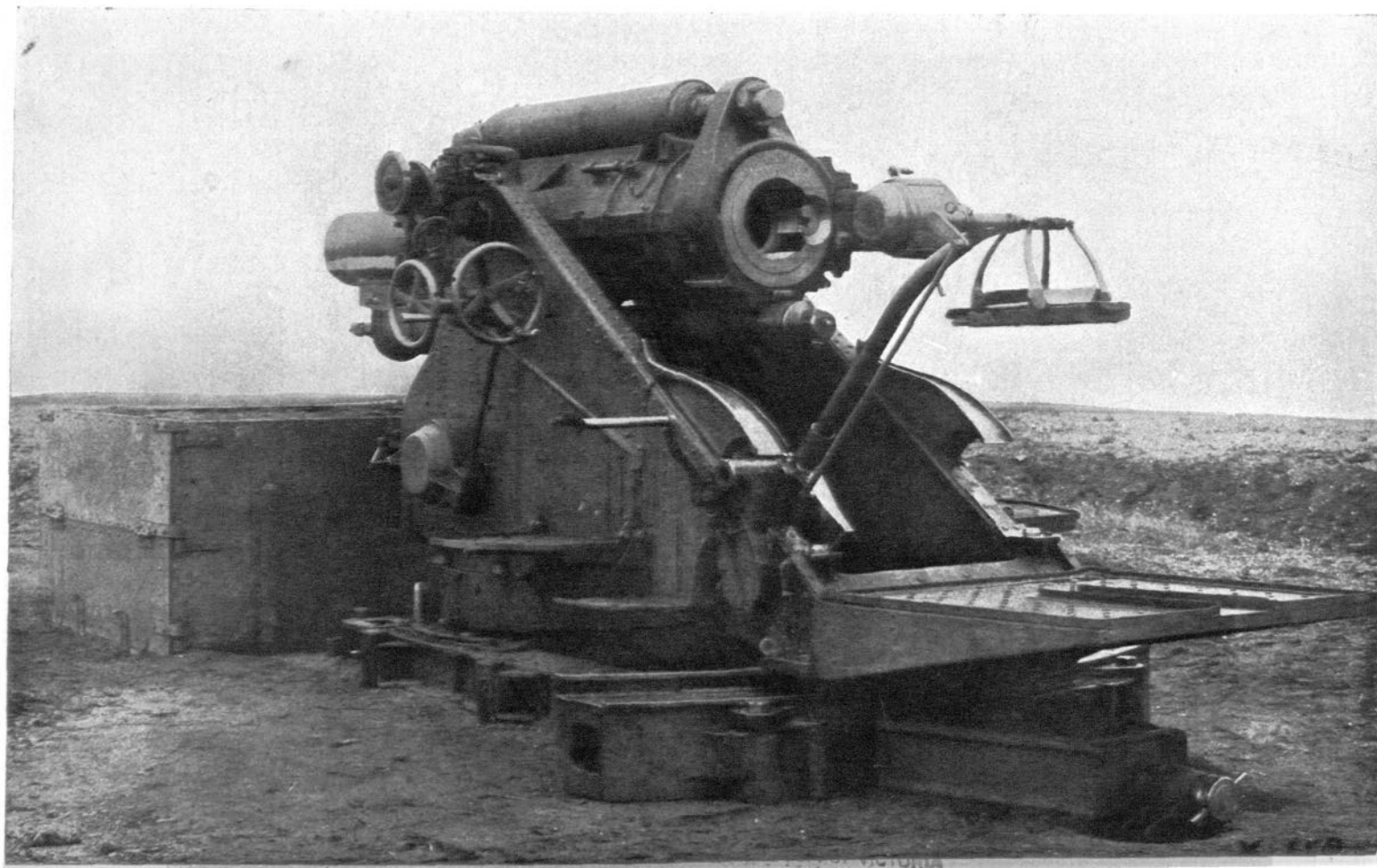
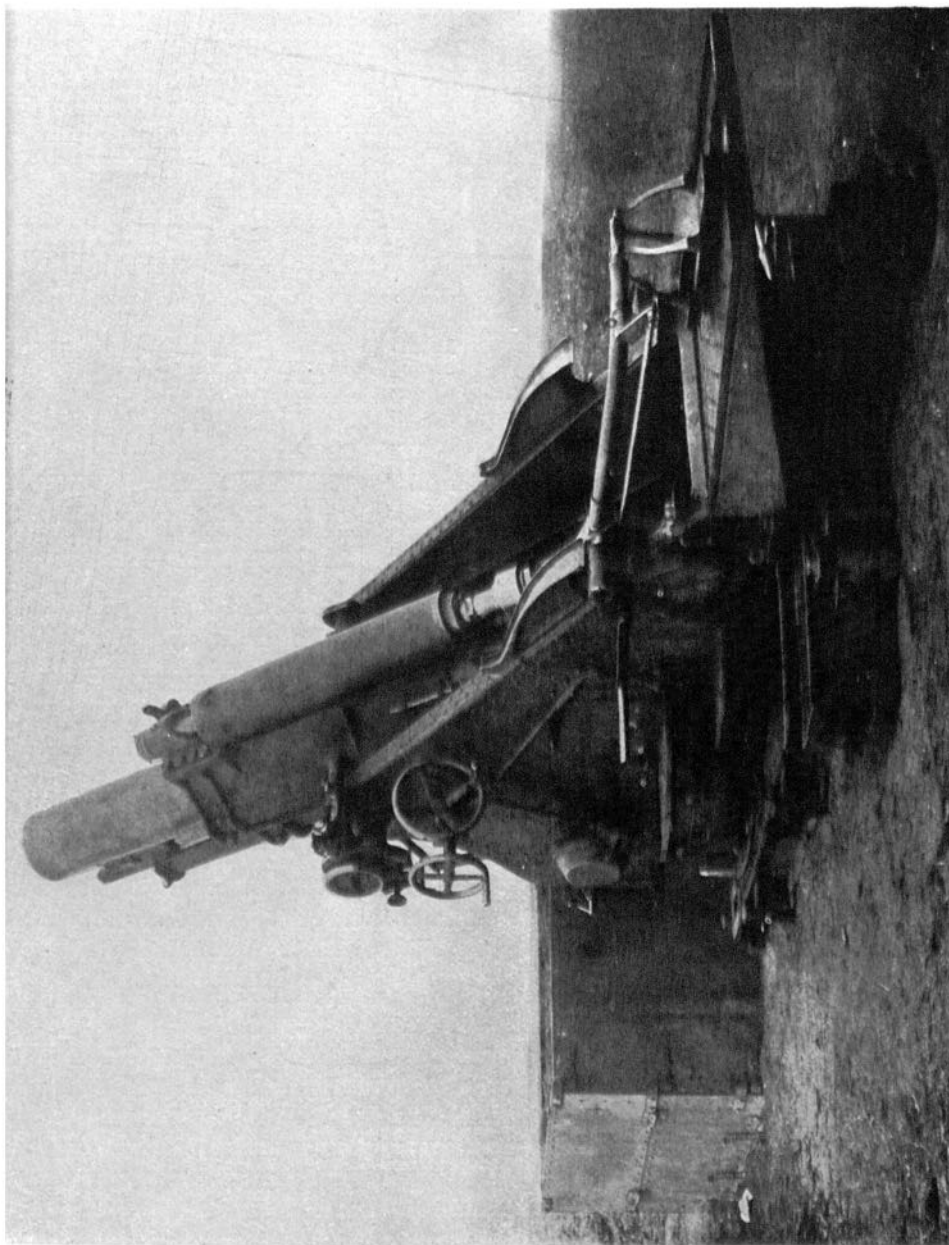
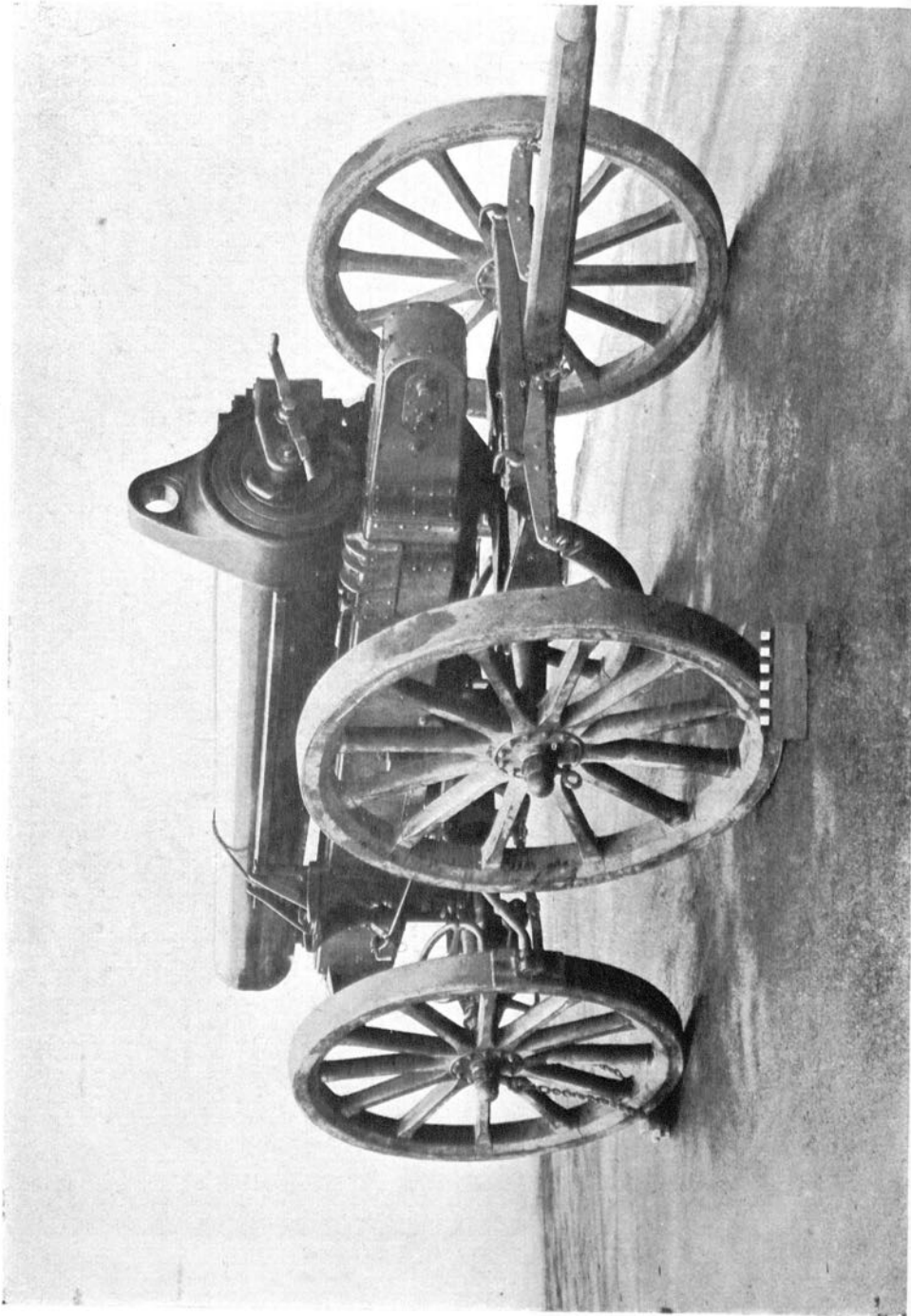


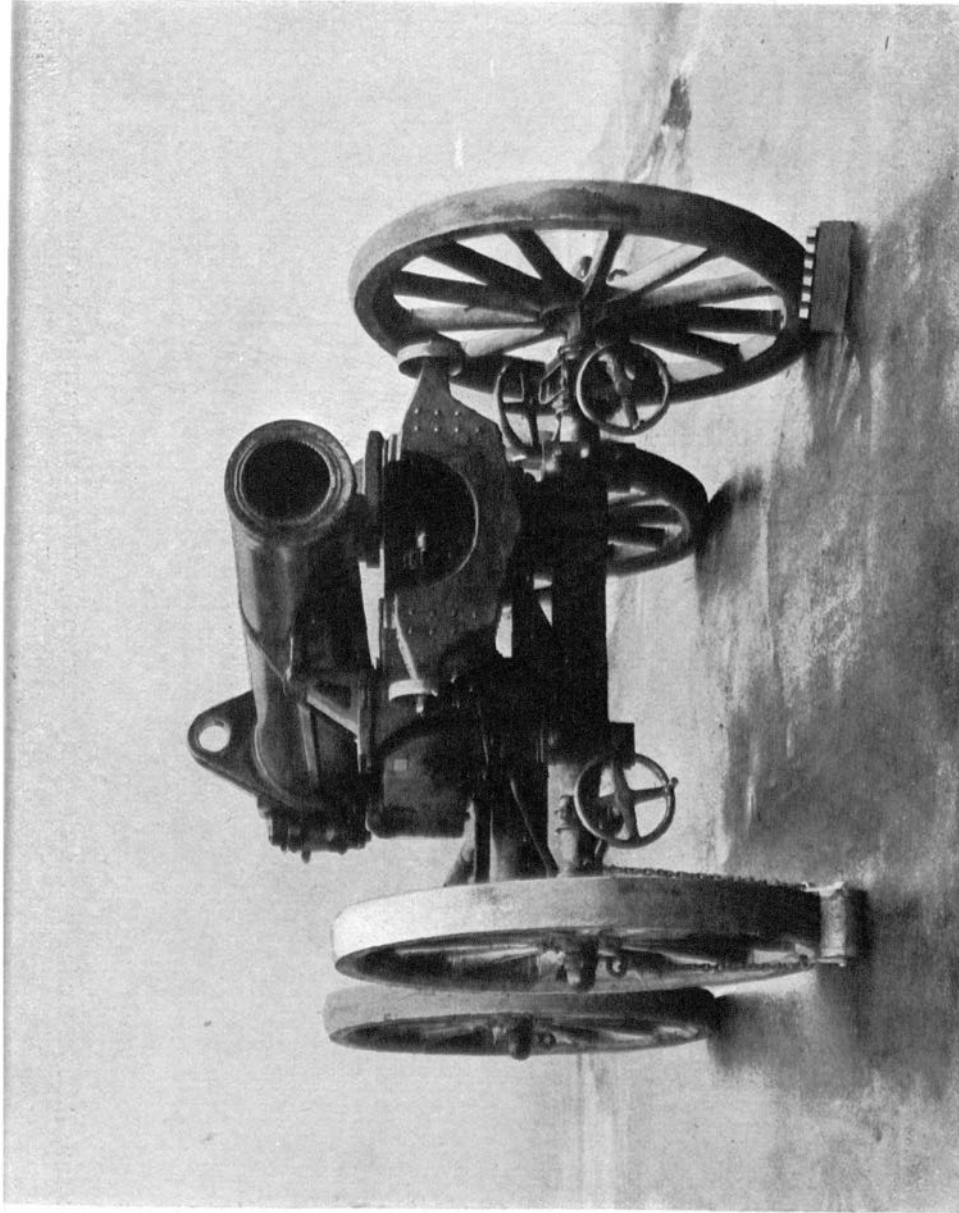
Plate X.



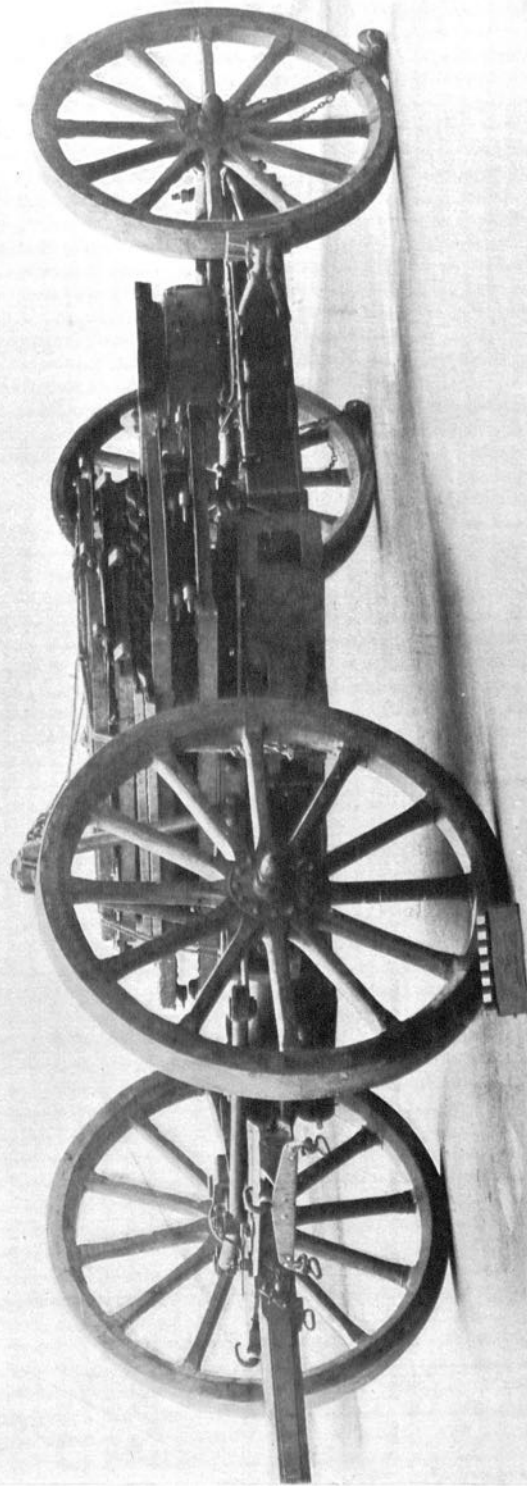
B.L. 9-2-INCH HOWITZER IN FIRING POSITION.

Plate XII.

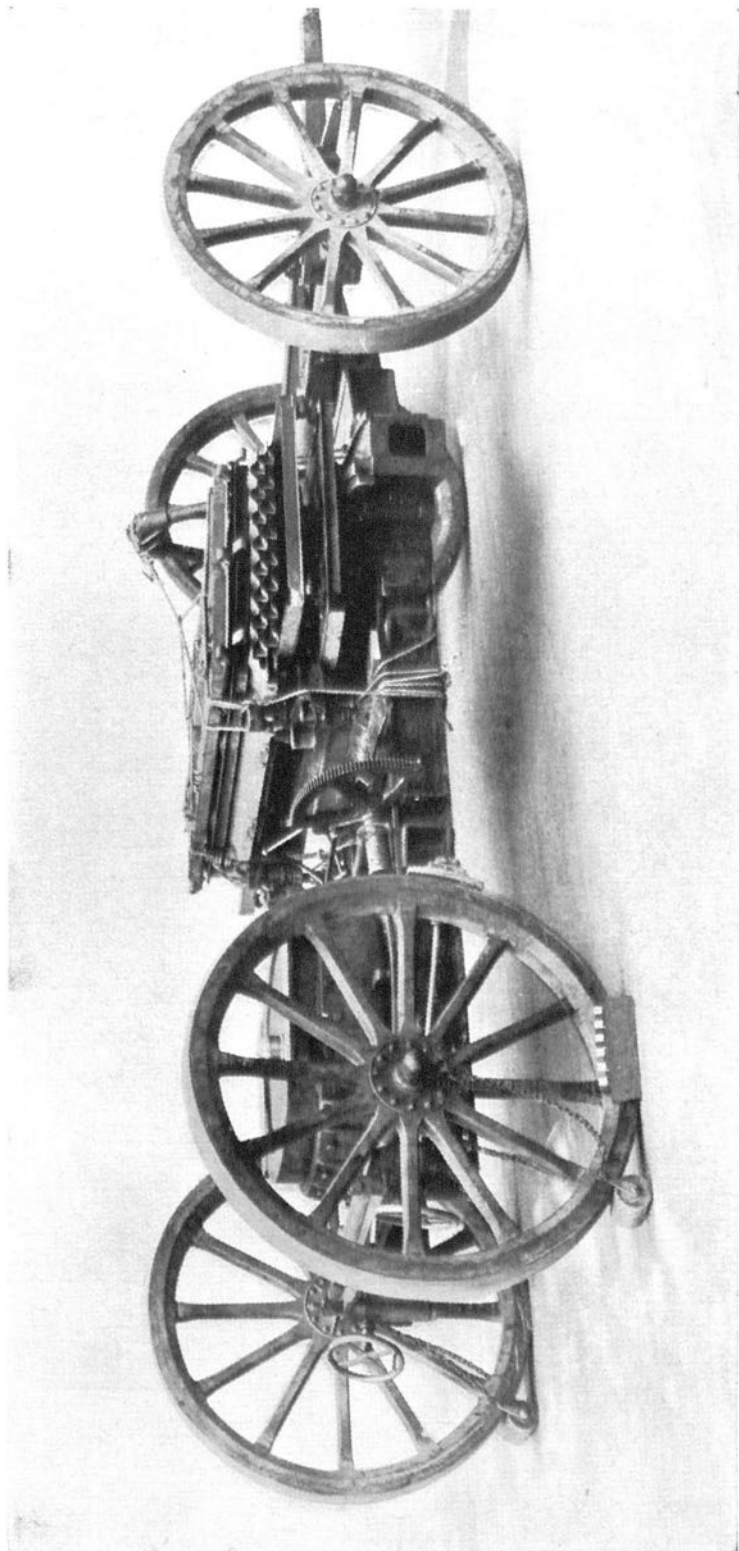




WAGON, TRANSPORTING, B.L. 9.2-INCH HOWITZER, WITH DRAUGHT POLE AND SWINGLETTREES.
(REAR VIEW.)

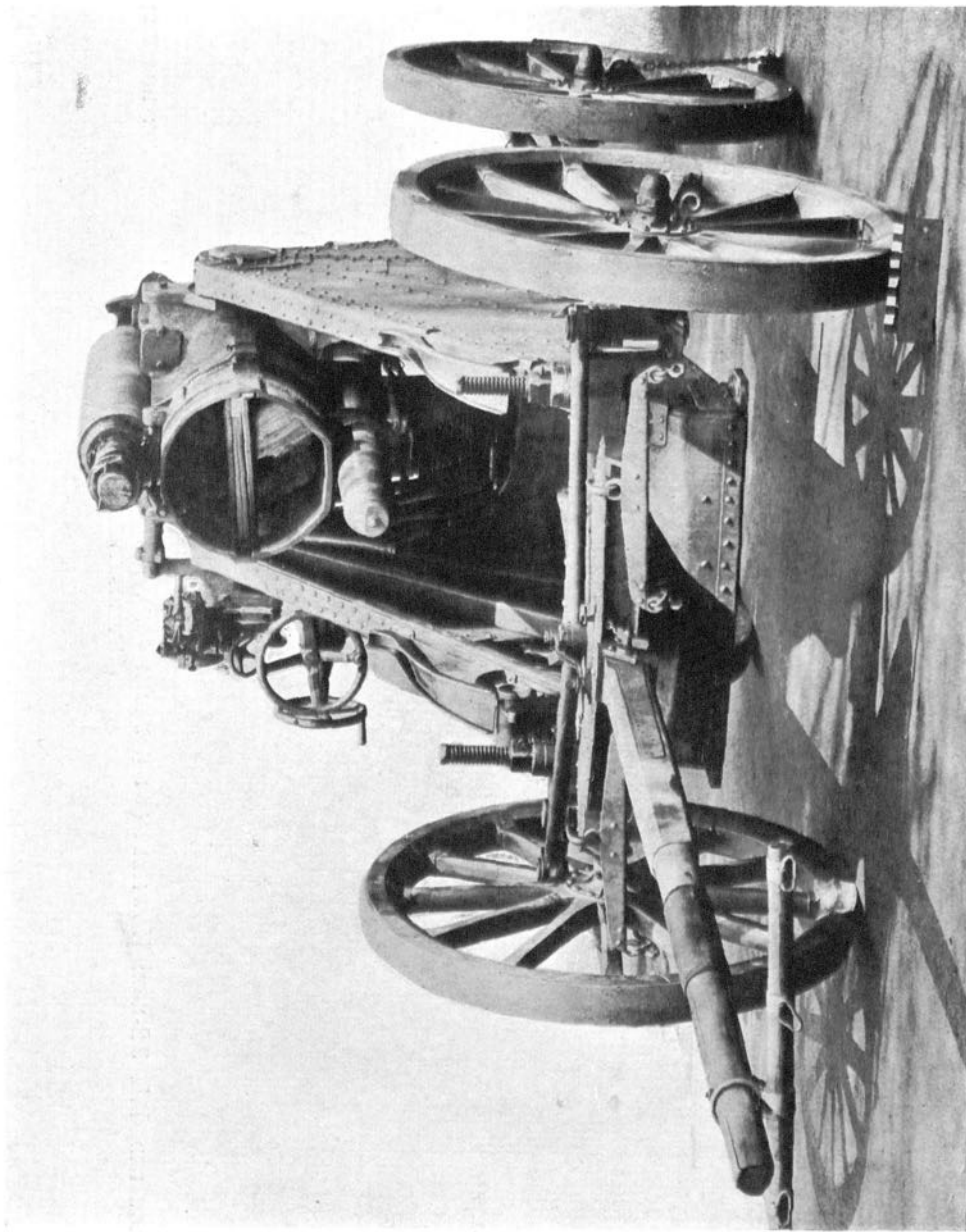


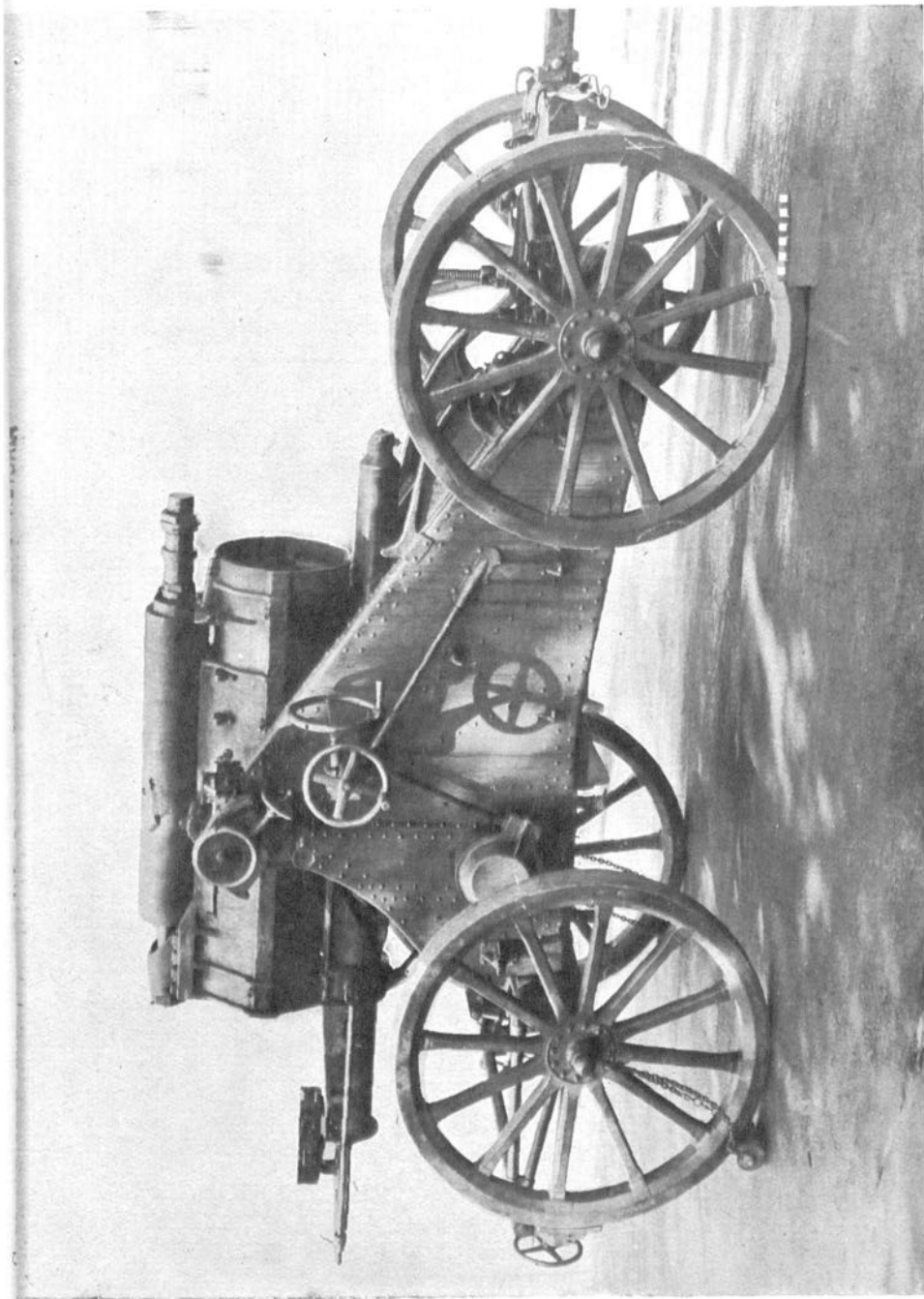
CARRIAGE BED, B.L. 9.2-INCH HOWITZER (WITH EARTH BOX), WITH TRANSPORTING ARRANGEMENT FOR HORSE DRAUGHT.
(NEAR SIDE.)



CARRIAGE BED, B.L. 9-2-INCH HOWITZER (WITH EARTH BOX), WITH TRANSPORTING ARRANGEMENT FOR HORSE DRAUGHT.
(OFF SIDE.)

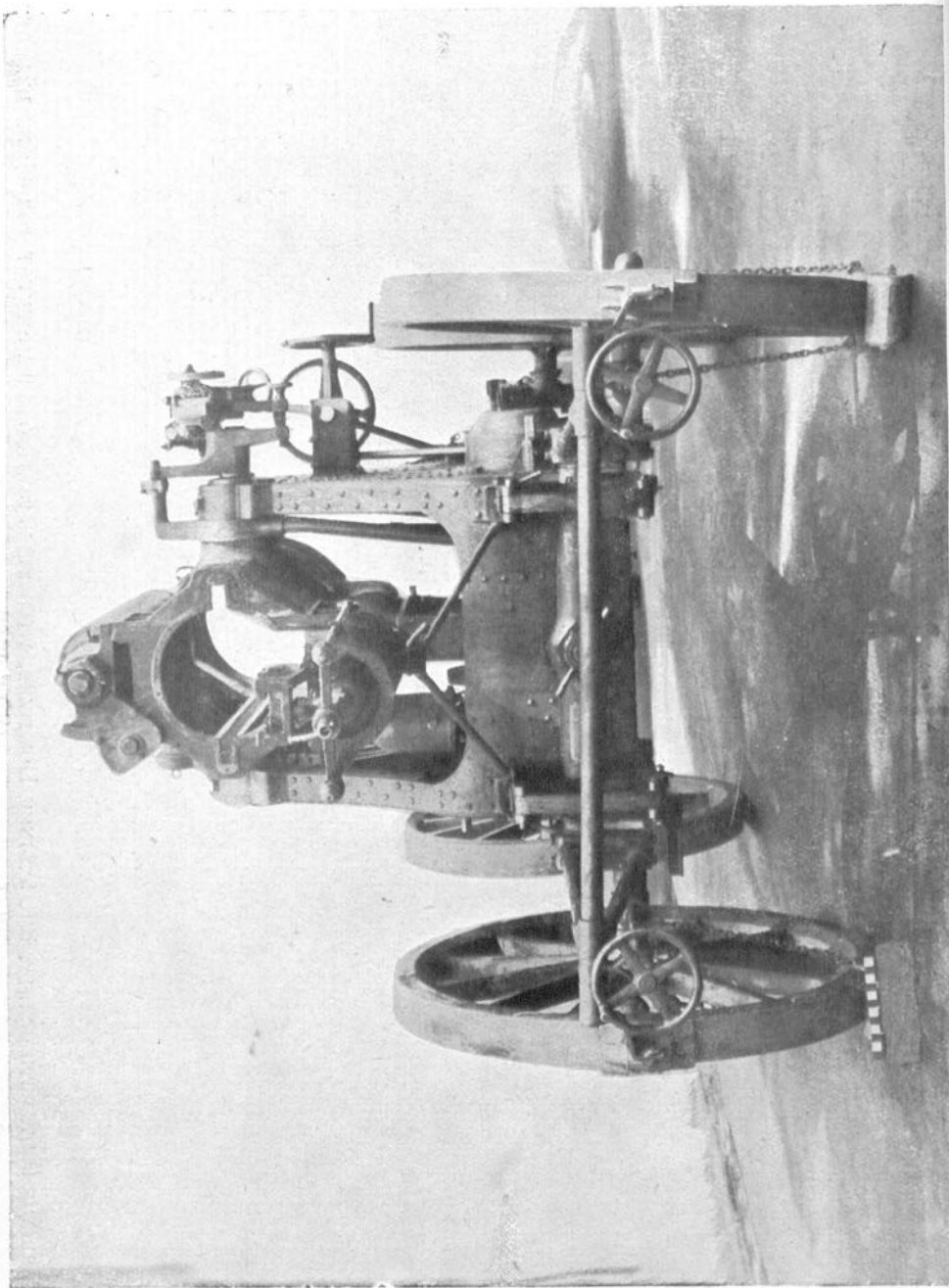
Plate XVI.

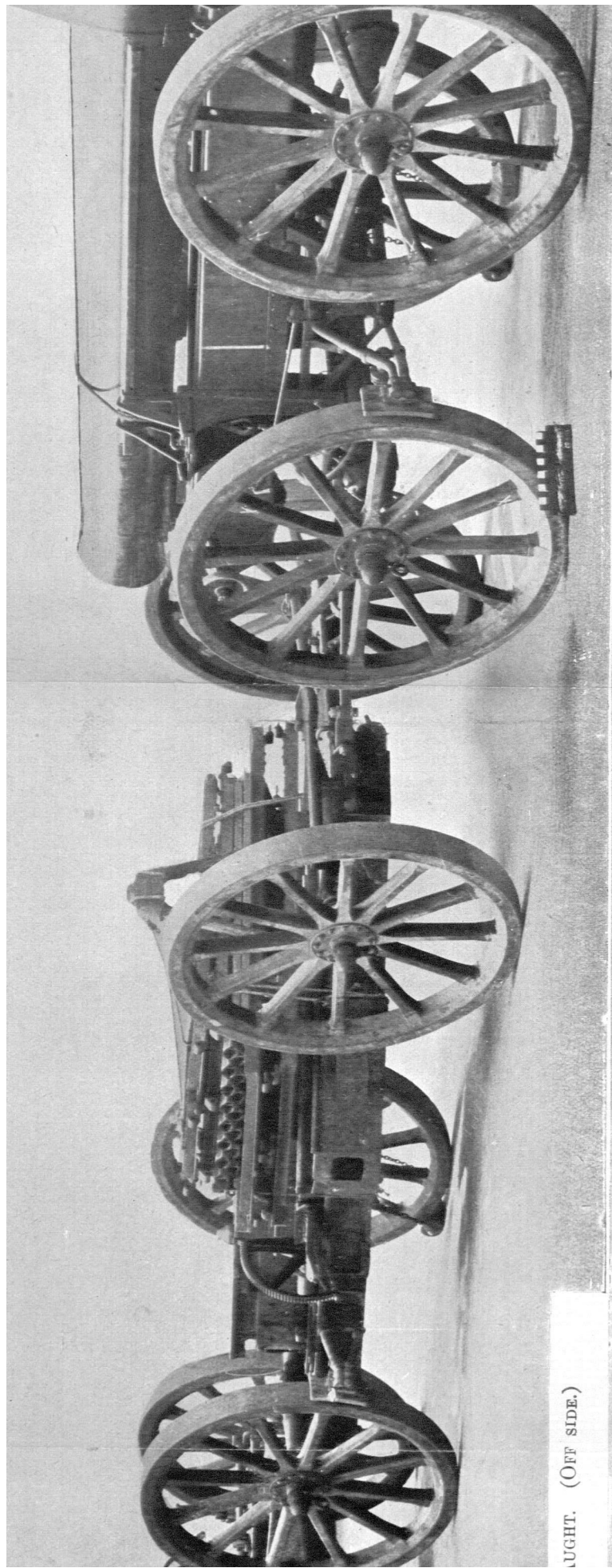




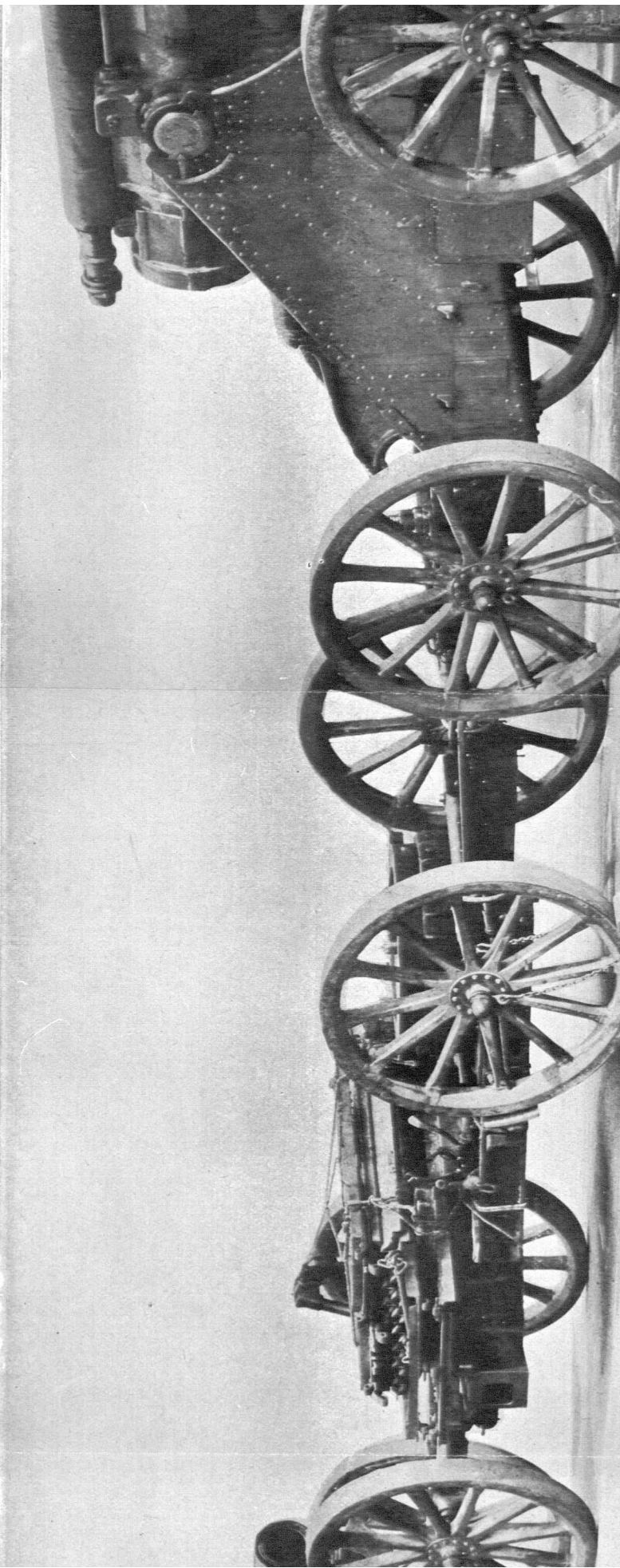
CARRIAGE BODY, WITH CRADLE, B.L. 9-2-INCH HOWITZER, WITH TRANSPORTING ARRANGEMENT FOR HORSE DRAUGHT.
(SIDE VIEW.)

Plate XVIII.





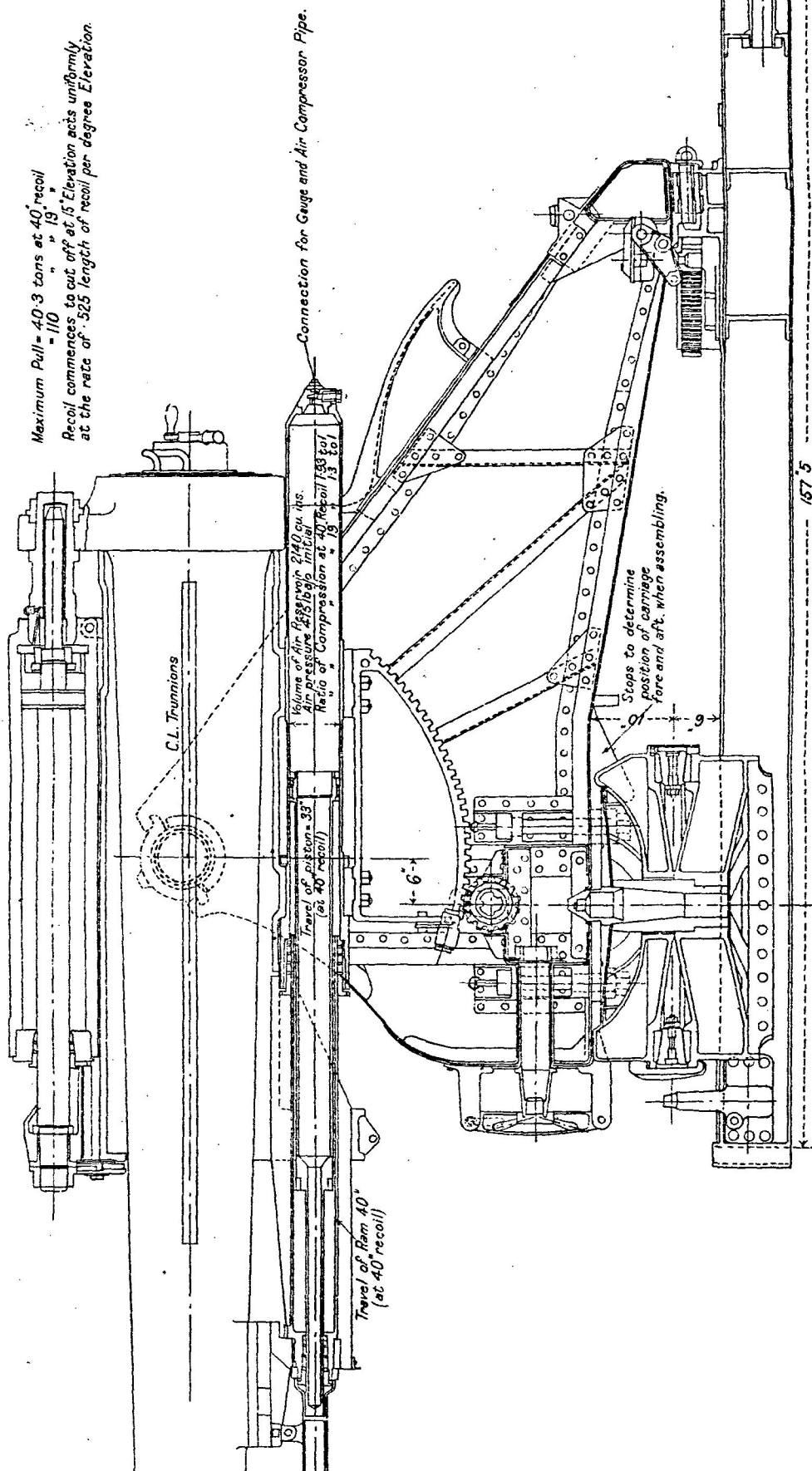
RIGHT. (OFF SIDE.)



CARRIAGE, SIEGE, B.L. 9.2-INCH HOWITZER, MARK I.

GENERAL ARRANGEMENT SHEWING SECTION THROUGH HYDRAULIC BUFFER AND RECUPERATOR.

SCALE = 1/20.



the extension of the sleeve and the angular reading noted.

be fixed by inserting split pins & securing the the "Nut, Buffer, Piston Rod", the Carriage will the dimension "B" in Fig. 7 will average about .30

CARRIAGE, SIEGE, B.L. 9.2" HOWITZER, MARK II.

Method of setting Cut-Off Gear.

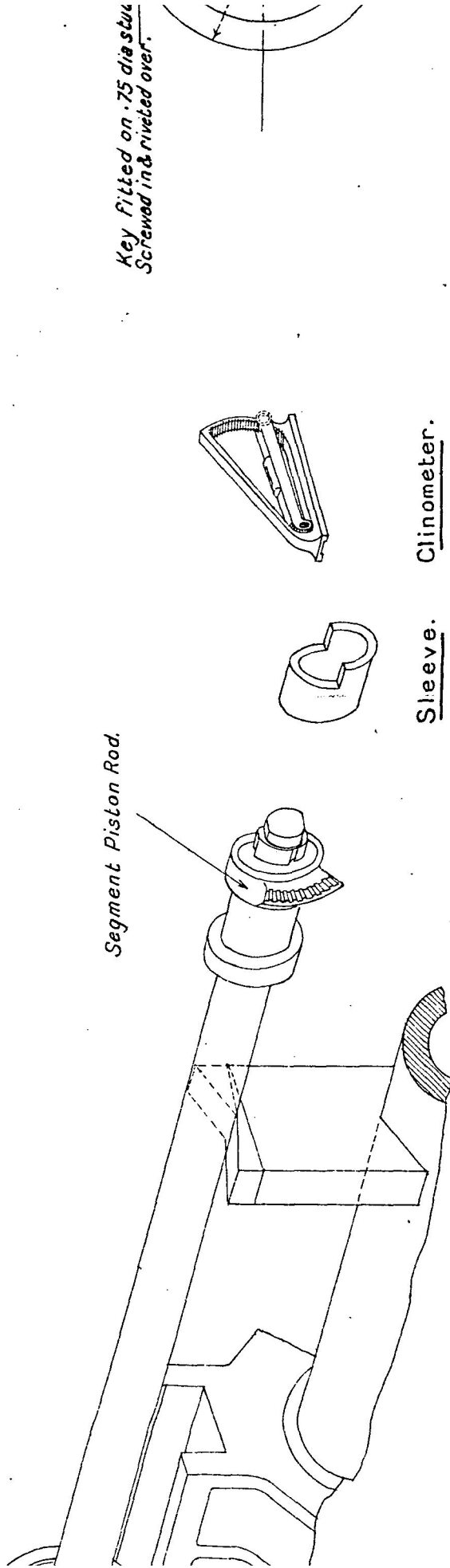


Fig.

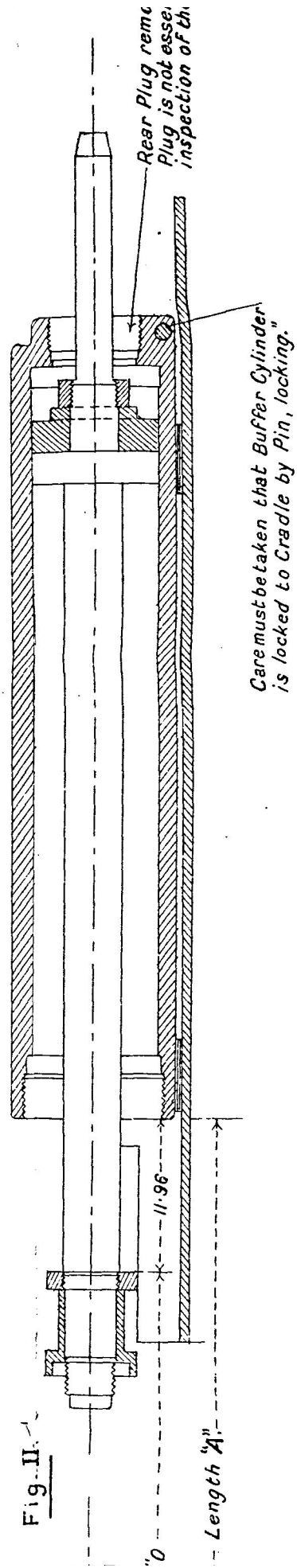
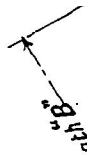


Fig. II.

Fig. VI.

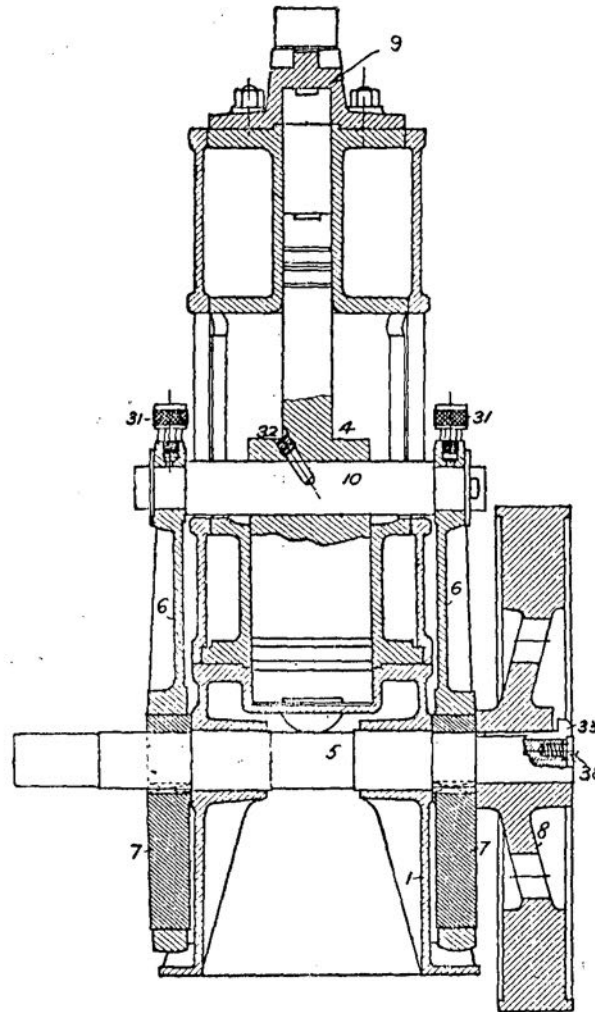
Fig. V.



PUMP, AIR, VERTICAL, TWO STAGE.
(Reavell's Type.)

TYPICAL.

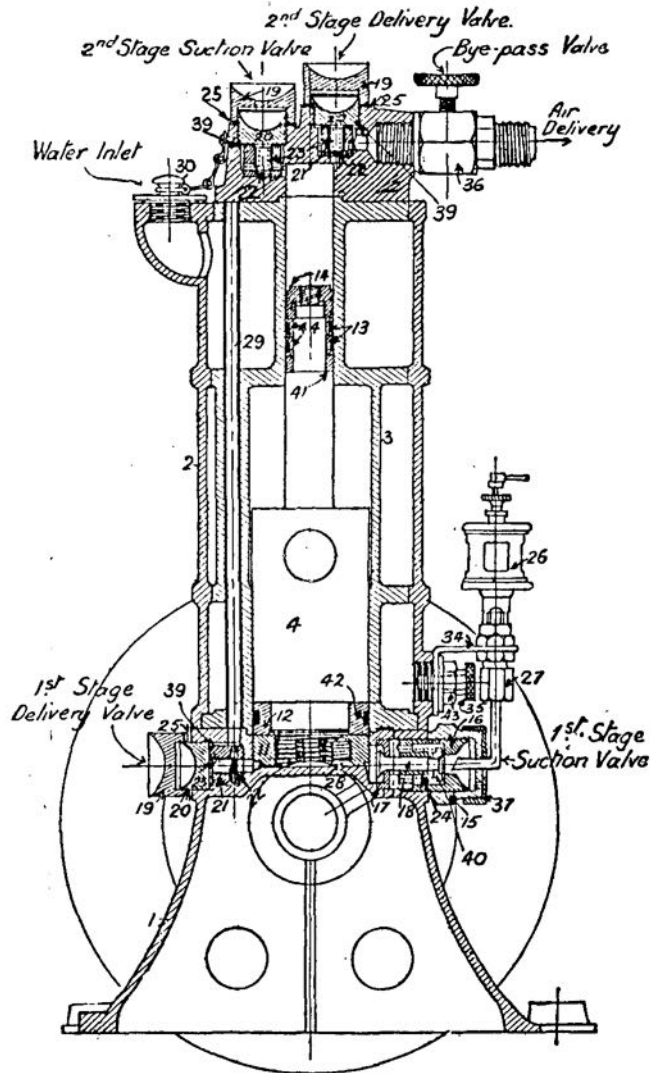
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- | | |
|----------------------|--------------------------------------|
| 1—Pedestal. | 12—Carrier, low pressure piston ring |
| 2—Casing, cylinder. | 13—Ring piston, high pressure. |
| 3—Cylinder. | 14—Junk ring, small. |
| 4—Piston. | 15—Cap, large valve. |
| 5—Shaft, eccentrics. | 16—Plug, large valve. |
| 6—Rod, eccentric. | 17—Seat, large valve. |
| 7—Eccentric. | 18—Valve, large. |
| 8—Flywheel. | 19—Cap, small valve. |
| 9—Cover, cylinder. | 20—Plug, small valve. |
| 10—Pin, gudgeon. | 21—Seat, small valve. |
| 11—Junk ring, large. | 22—Valve, small. |

PUMP, AIR, VERTICAL, TWO STAGE.
(Reavell's Type.)

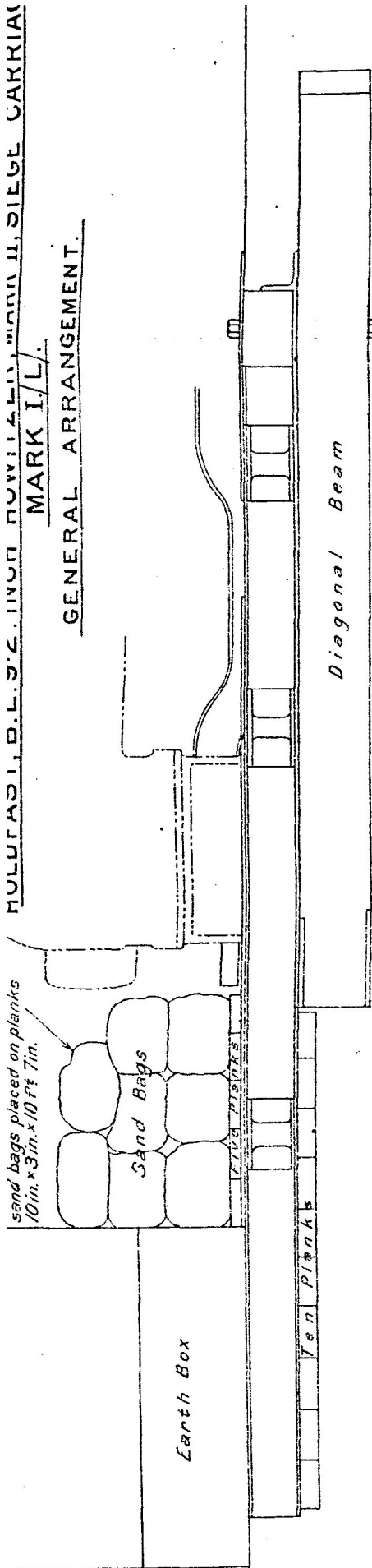
TYPICAL.



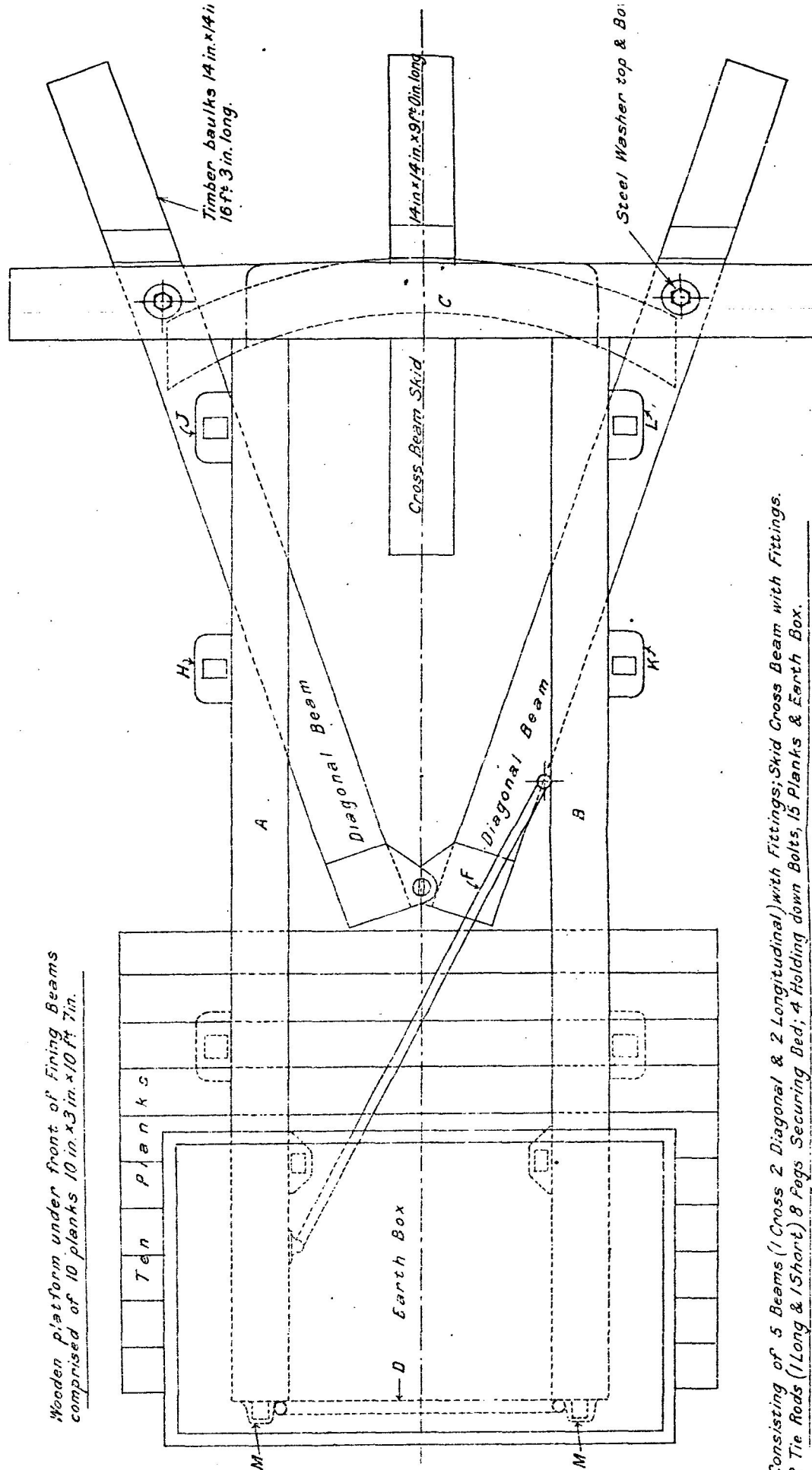
- | | |
|-------------------------------------|---|
| 23—Spring, valve, small. | 35—Plug, water outlet. |
| 24—Spring, large valve. | 36—Connection, delivery pipe. |
| 25—Washer packing, small valve cap. | 37—Cover, large valve. |
| 26—Lubricator, drip. | 38—Screw, securing flywheel. |
| 27—Pipe, lubricating. | 39—Washer, packing, small valve plug. |
| 28—Screw keep, L.P. junk ring. | 40—Collar, large valve. |
| 29—Pipe, copper. | 41—Collar, distance, high pressure rings. |
| 30—Plug, filling hole. | 42—Ring, piston, low pressure. |
| 31—Lubricator Stauffer. | 43—Plug, drain hole. |
| 32—Stud, locating gudgeon. | 44—Carrier, high pressure. |
| 33—Key flywheel. | |
| 34—Bracket, lubricator. | |

MARK I, L.

GENERAL ARRANGEMENT.



Wooden platform under front of Firing Beams comprised of 10 planks 10 in. x 3 in. x 10 ft 7 in.

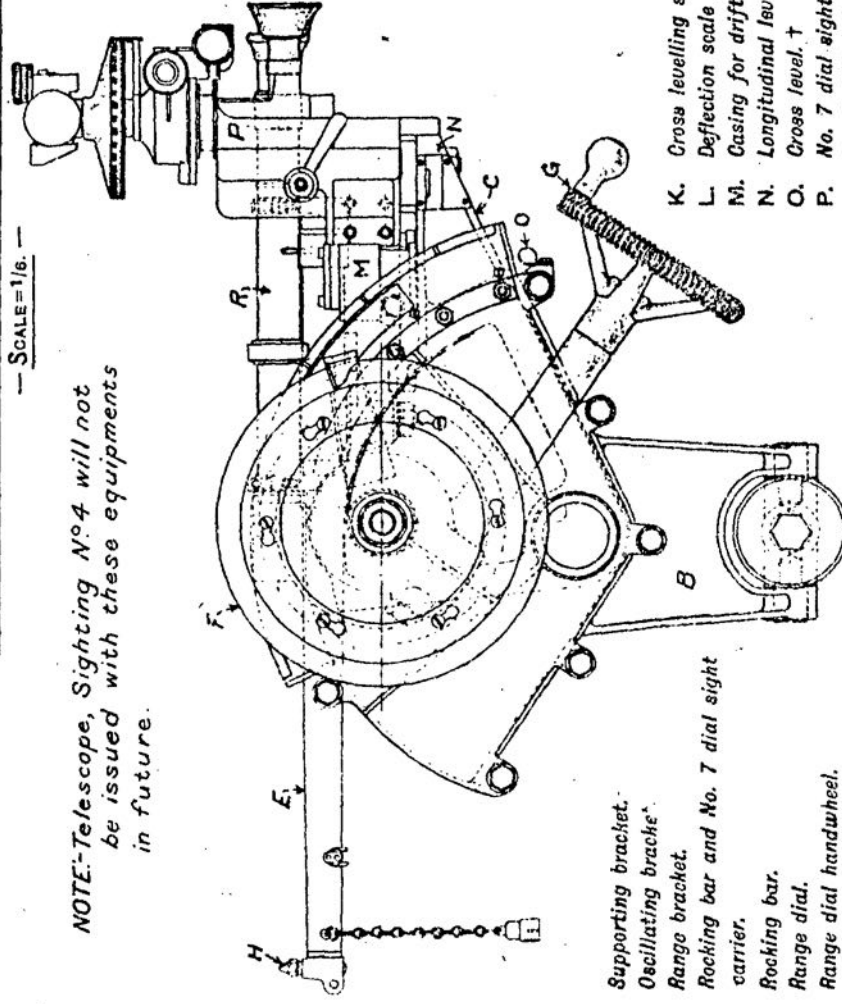
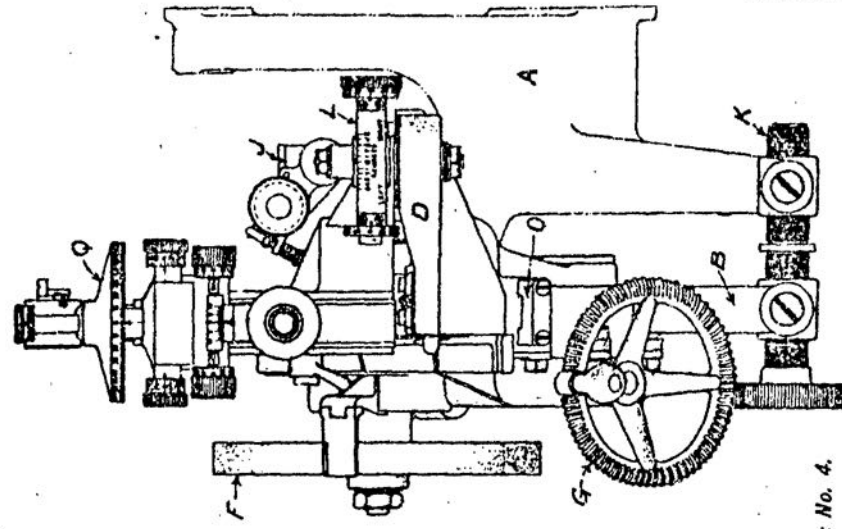


Consisting of 5 Beams (1 Cross 2 Diagonal & 2 Longitudinal) with Fittings; Skid Cross Beam with Fittings. 2 Tie Rods (1 Long & 1 Short) 8 Fogs Securing Bed; 4 Holding down Bolts, 15 Planks & Earth Box.

GENERAL ARRANGEMENT WITH SIGHTING TELESCOPE No. 4
No. 7 DIAL SIGHT AND No. 4 CARRIER IN POSITION.

— SCALE = 1/8. —

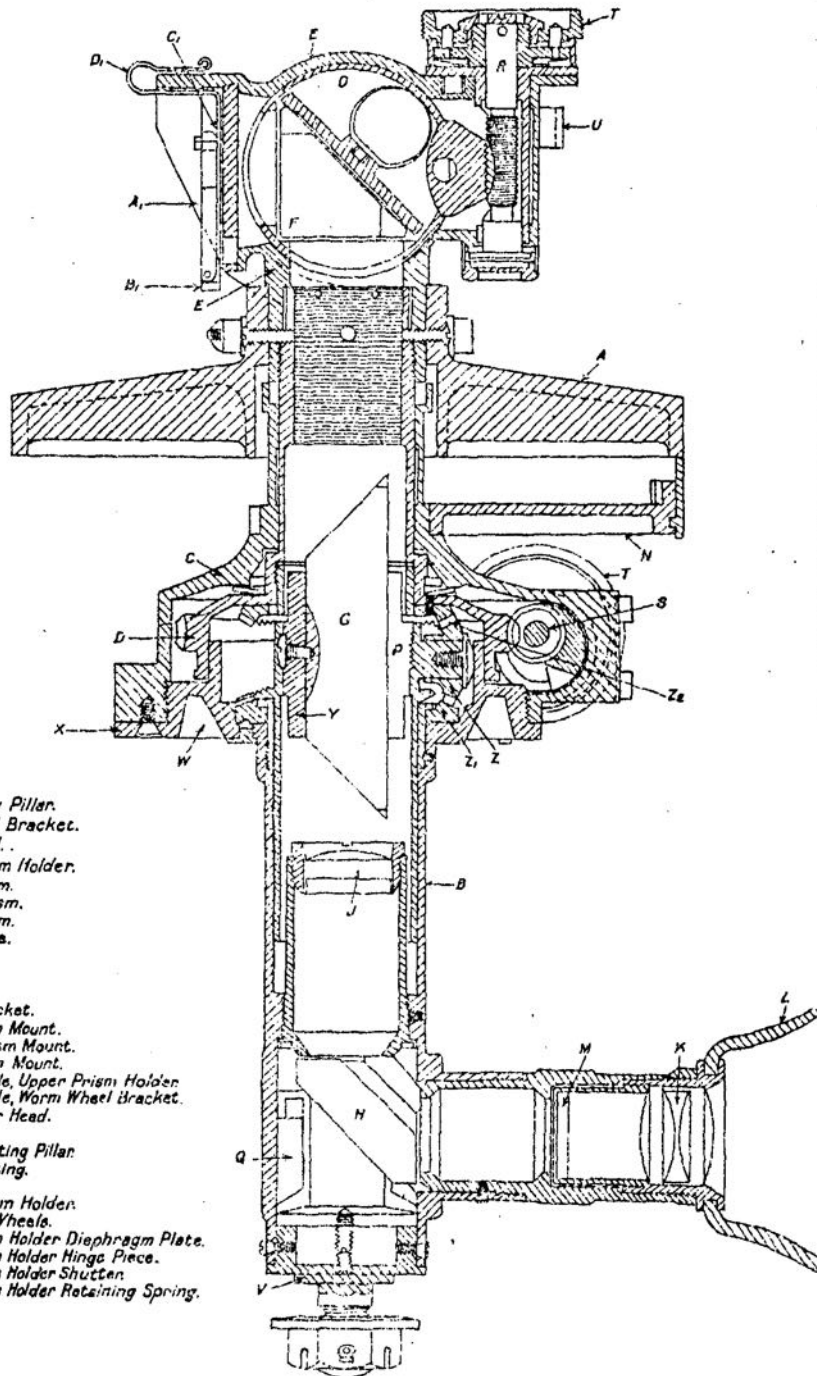
NOTE:—Telescope, Sighting No. 4 will not
be issued with these equipments
in future.



- A. Supporting bracket.
- B. Oscillating bracket.
- C. Range bracket.
- D. Rocking bar and No. 7 dial sight carrier.
- E. Rocking bar.
- F. Range dial.
- G. Range dial handwheel.
- H. Fore sight.
- J. Rear sight.
- K. Cross levelling screw.
- L. Deflection scale plate.
- M. Casing for drift cam.
- N. Longitudinal level.
- O. Cross level. †
- P. No. 7 dial sight carrier No. 4.
- Q. No. 7 dial sight.
- R. No. 4 sighting telescope.

† In future the cross-level carrier will be secured to a supporting bracket attached to the body of the range bracket and not on the oscillating bracket as shown.

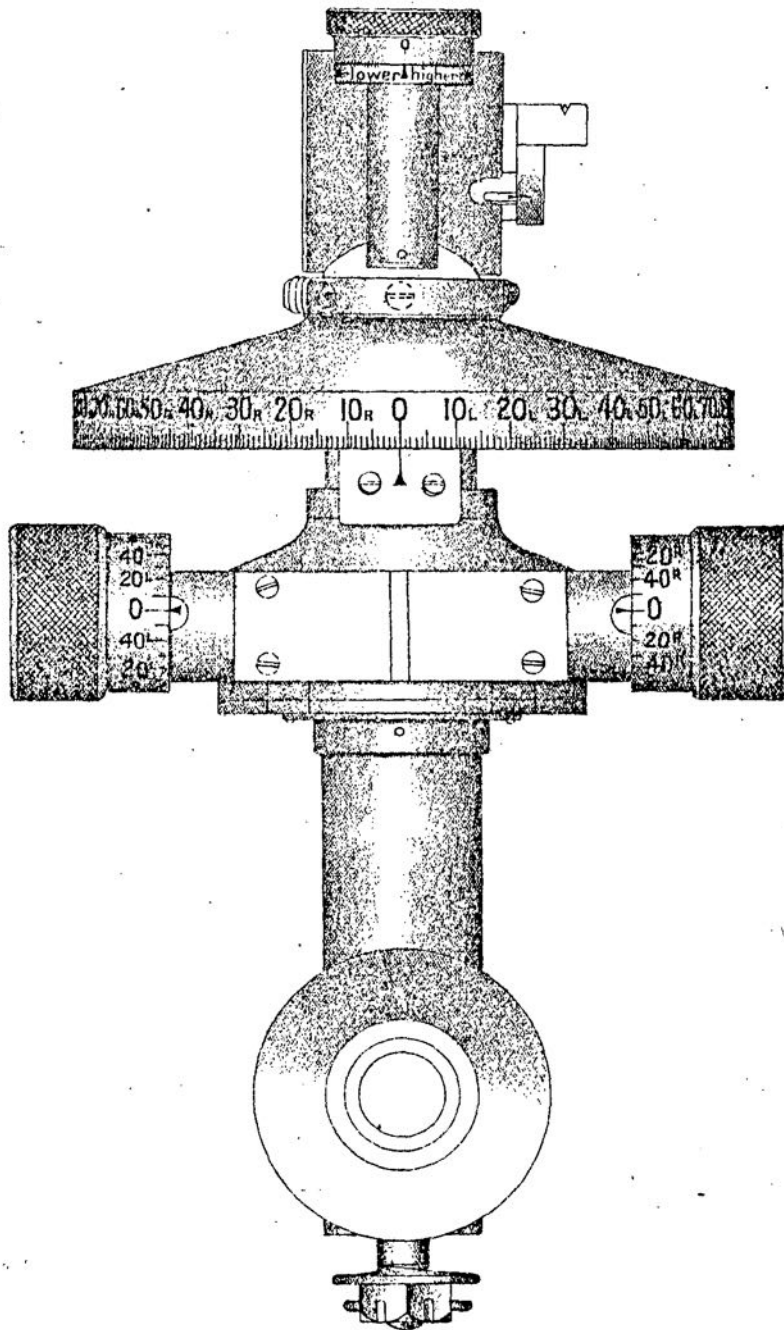
SIGHT, DIAL, NO 7, MARK III.



- A. Dial Plate.
- B. Supporting Pillar.
- C. Wormwheel Bracket.
- D. Wormwheel.
- E. Upper Prism Holder.
- F. Upper Prism.
- G. Centre Prism.
- H. Lower Prism.
- J. Object Glass.
- K. Eyepiece.
- L. Eyeguard.
- M. Diaphragm.
- N. Reader Bracket.
- O. Upper Prism Mount.
- P. Centre Prism Mount.
- Q. Lower Prism Mount.
- R. Worm Spindle, Upper Prism Holder.
- S. Worm Spindle, Worm Wheel Bracket.
- T. Micrometer Head.
- U. Crosshead.
- V. Plug supporting Pillar.
- W. Coned Seating.
- X. Projection.
- Y. Centre Prism Holder.
- Z, Z1, Z2. Bevel Wheels.
- A1. Upper Prism Holder Diaphragm Plate.
- B1. Upper Prism Holder Hinge Piece.
- C1. Upper Prism Holder Shutter.
- D1. Upper Prism Holder Retaining Spring.

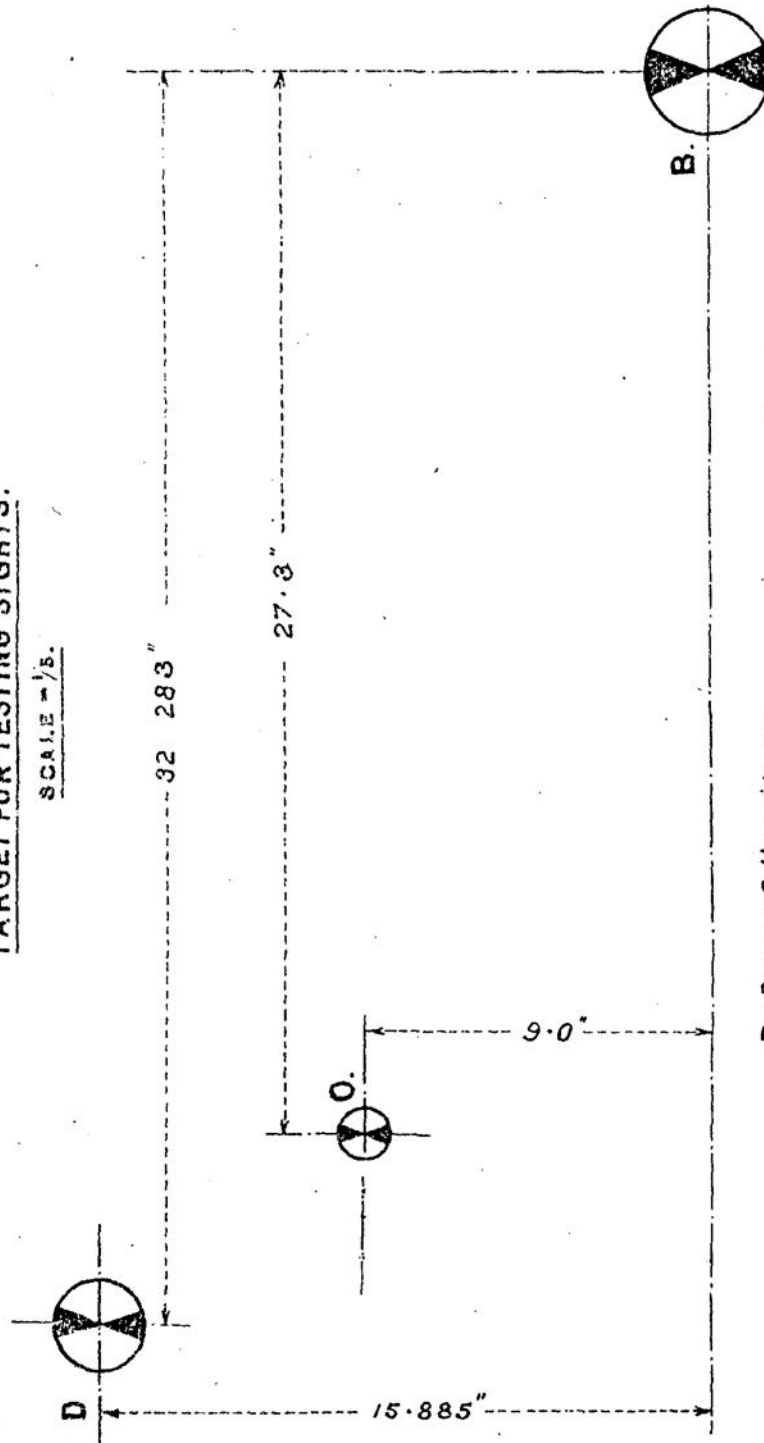
SIGHT, DIAL. N° 7. MARK III.

SCALE $\frac{2}{3}$



B.L. 9.2-INCH MARK I HOWITZER.
TARGET FOR TESTING SIGHTS.

SCALE = $\frac{1}{8}$.

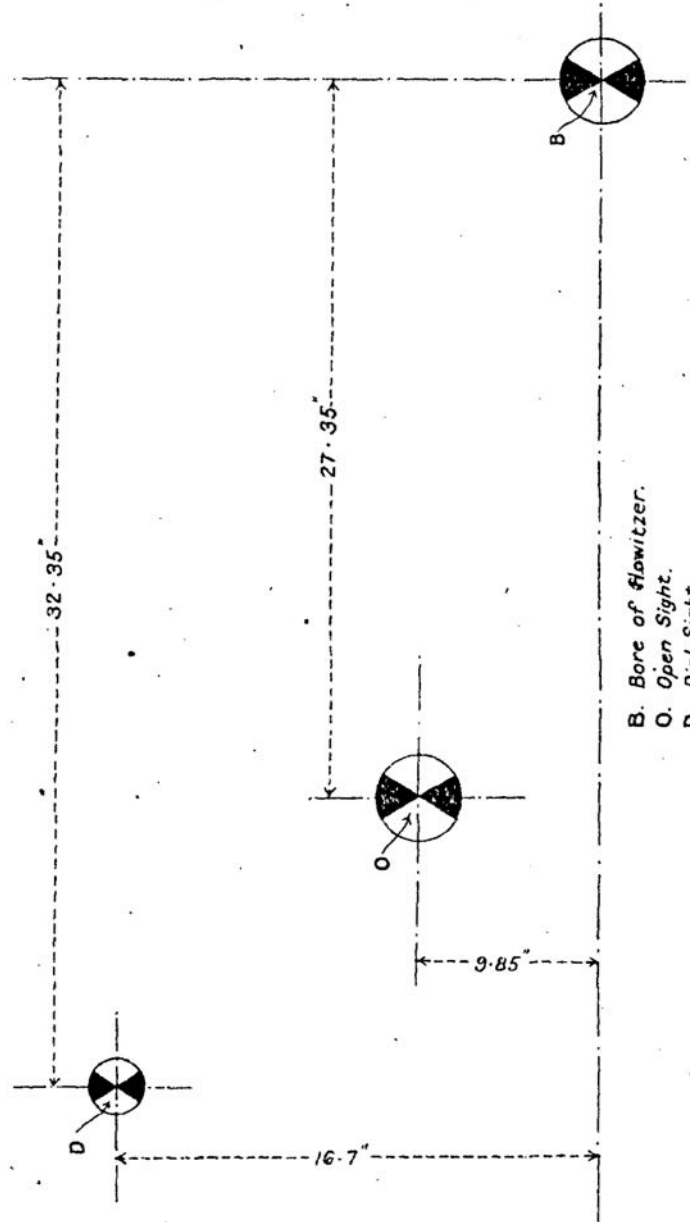


B = Bore of Howitzer.
 O = Open Sight.

D = Dial Sight.

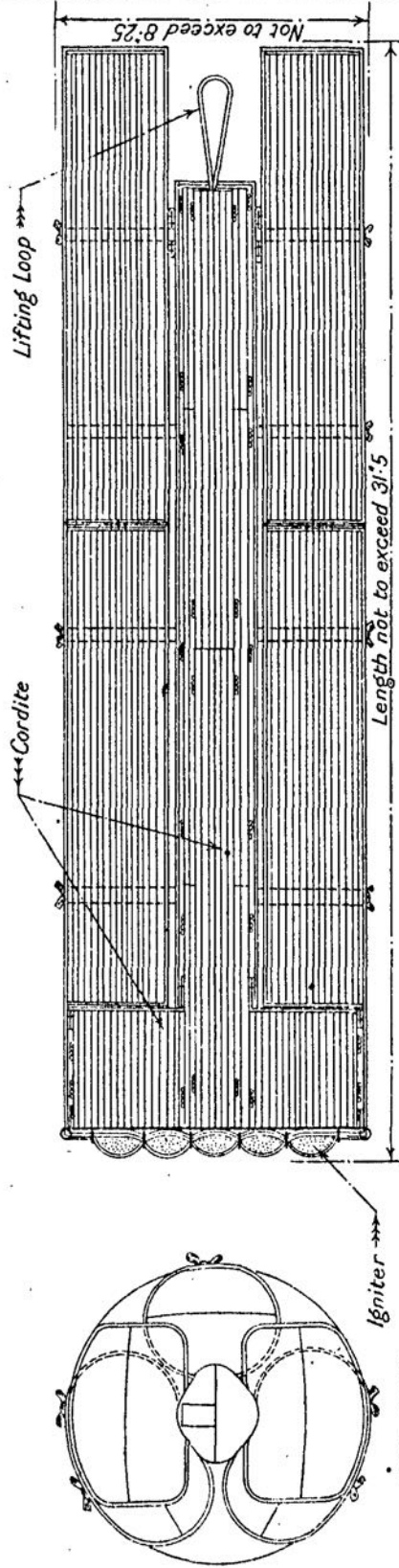
B. L. 9.2-INCH MARK II. HOWITZER.

TARGET TESTING SIGHTS.



CARTRIDGE, B. L. 9-2-IN. HOWITZER 23-LB. 12-OZS. CORDITE, M. D. T. OR, R. D. B. T. SIZE 20-10., MARK III.

WEIGHT OF CORDITE		LBS.	OZS.	DRS.
N ^o 1 SECTION (CORE)		8	1	0
N ^o 2	"	2	2	8
N ^o 3	"	2	11	8
N ^o 4	"	3	5	4
N ^o 5	"	3	15	12
N ^o 6	"	3	8	0
TOTAL		23	12	0



CARTRIDGE, B.L. 9.2-INCH HOWITZER, I.H.B. 13 OZ CORDITE R.D.B OR M.D. SIZE 12. MARK I L.

SCALE 1/2.

Silk or Shalloon Braids.

Cordite.

Igniter

Becket.

Length not to exceed 7.75

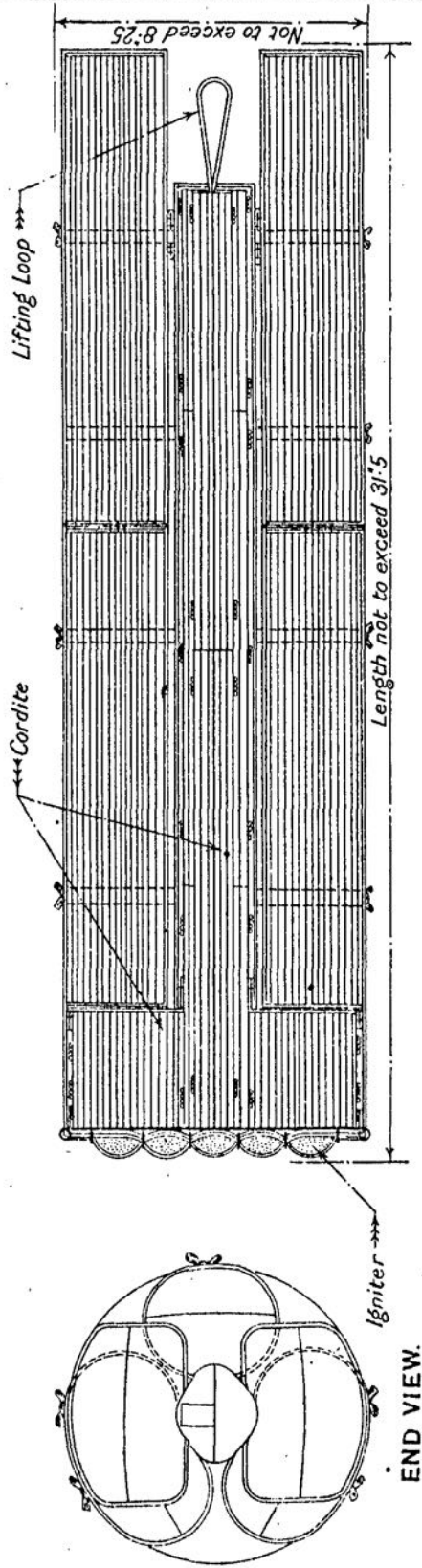
Not to exceed 9.0

WEIGHT OF CORDITE.

No	Section (core)	7 lb.	1 oz.	8 drs.
Nº 2	"	1	9	2
Nº 3	"	1	0	9
Nº 4	"	2	1	13
Total		11 lb.	13 oz.	0 drs

CARTRIDGE, B. L. 9.2-IN. HOWITZER 23-LB. 12-OZS. CORDITE, M. D. T. OR, R. D. B. T. SIZE 20-10, MARK III.

WEIGHT OF CORDITE		LBS.	OZS.	DRS.
No 1 SECTION (CORE)		8	1	0
No 2	"	2	2	8
No 3	"	2	11	8
No 4	"	3	5	4
No 5	"	3	15	12
No 6	"	3	8	0
TOTAL		23	12	0



CARTRIDGE, B.L. 9.2-INCH HOWITZER, 11LB. 13 OZ CORDITE R.D.B OR M.D. SIZE 12. MARK I L.

SCALE 1/2.

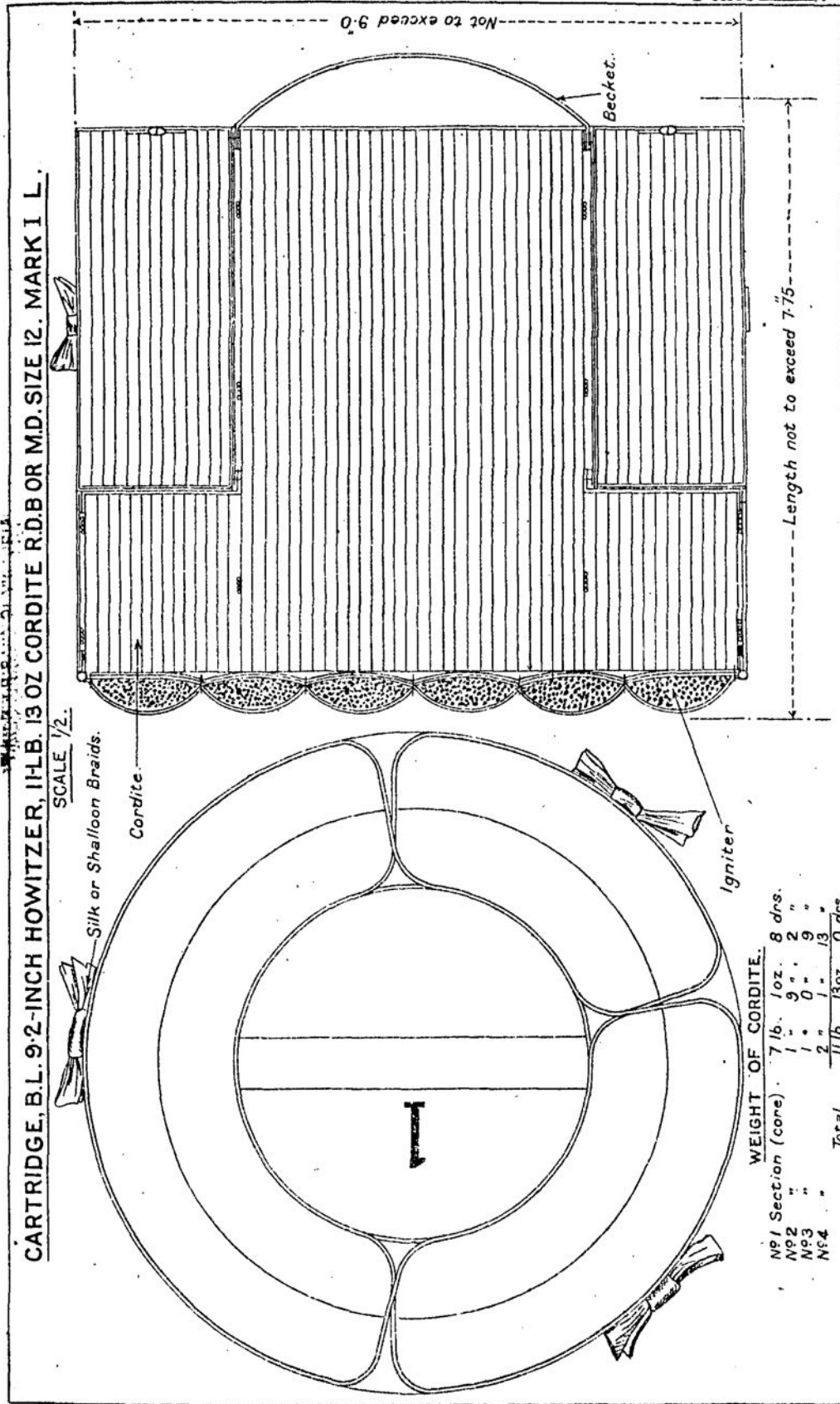
Silk or Shalloon Braids.

Cordite.

Igniter

WEIGHT OF CORDITE.

No	Section (core)	7 lb.	1 oz.	8 drs.
No 1		1	9	2
No 2		1	0	9
No 3		2	1	13
No 4		11	13	0
Total		11	16	13

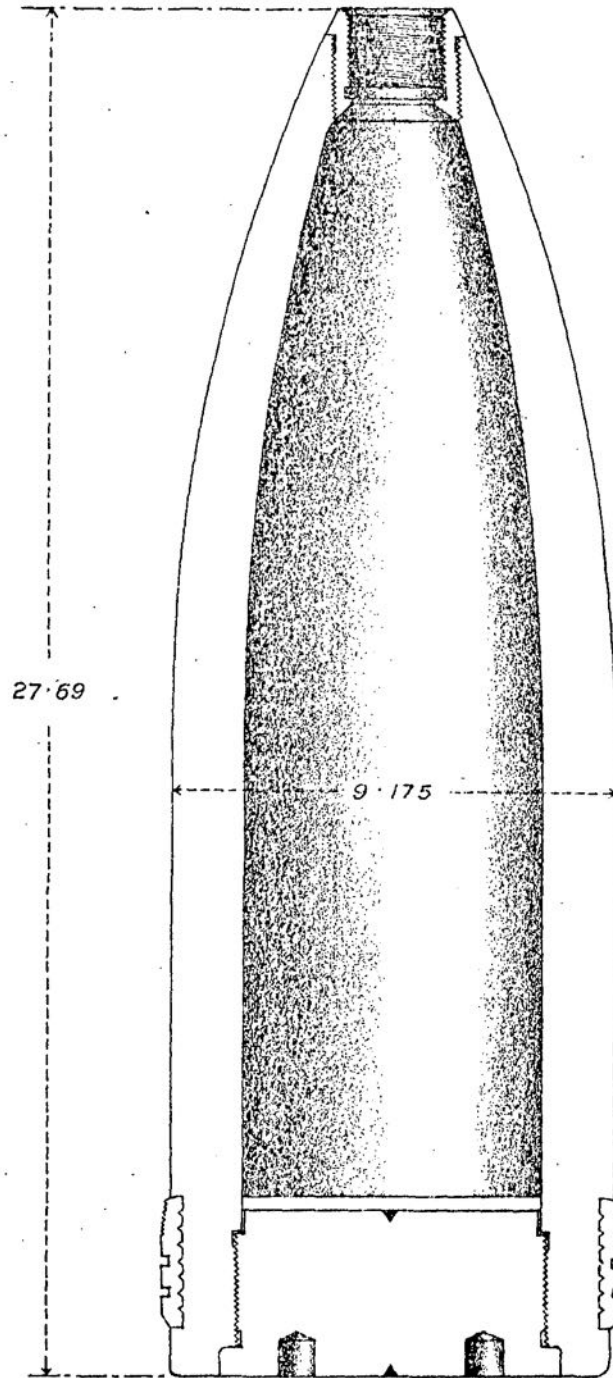


Not to exceed 9.0

Length not to exceed 7.75

SHELL, B.L. HIGH EXPLOSIVE, 9.2-INCH HOWITZER. MARK XVA.

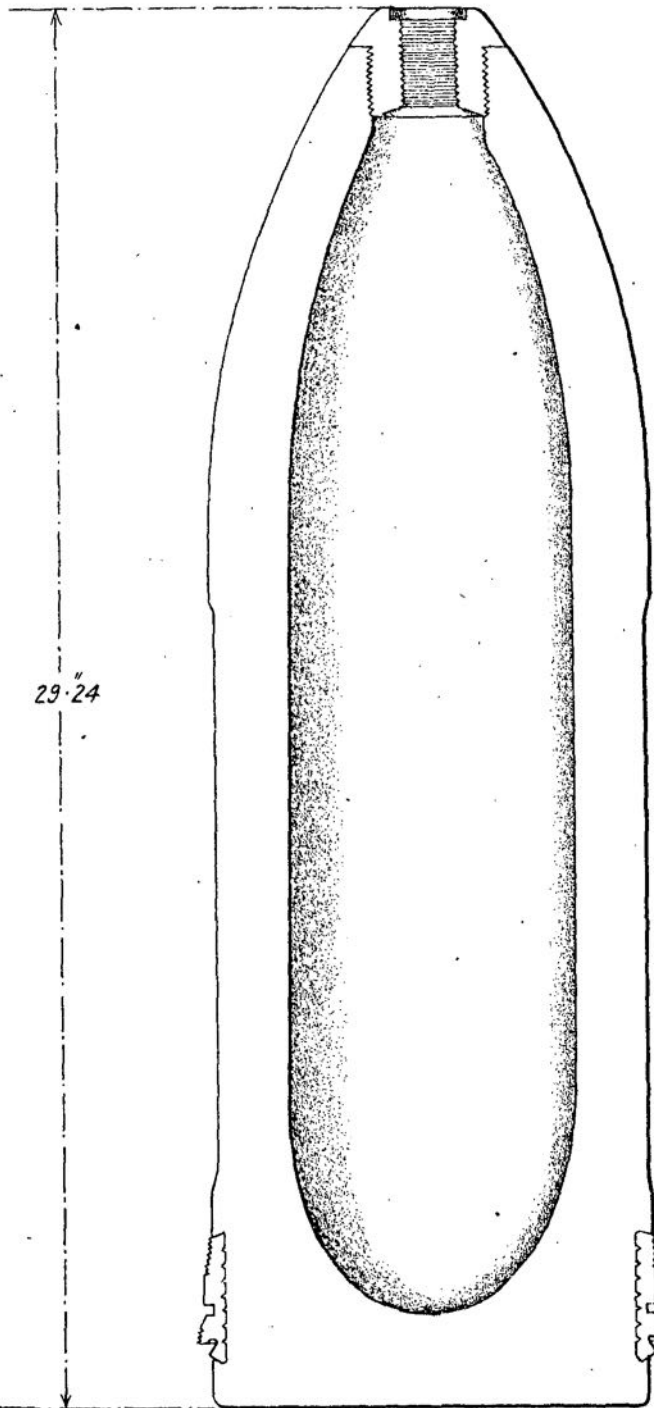
Scale $\frac{1}{4}$.



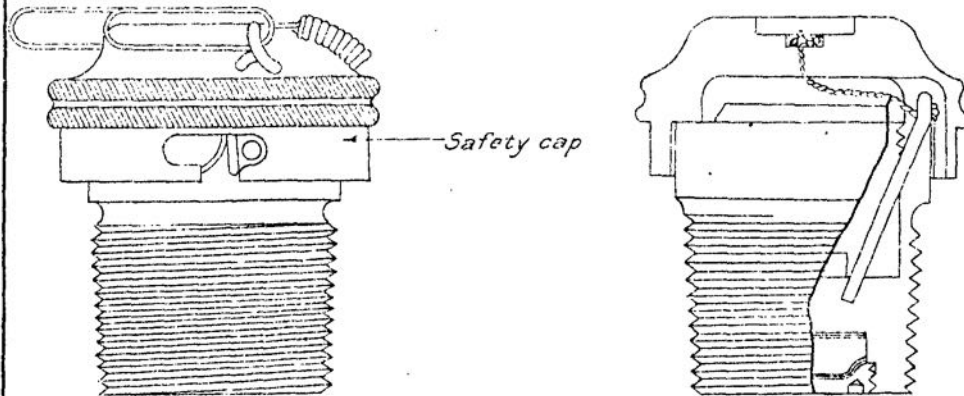
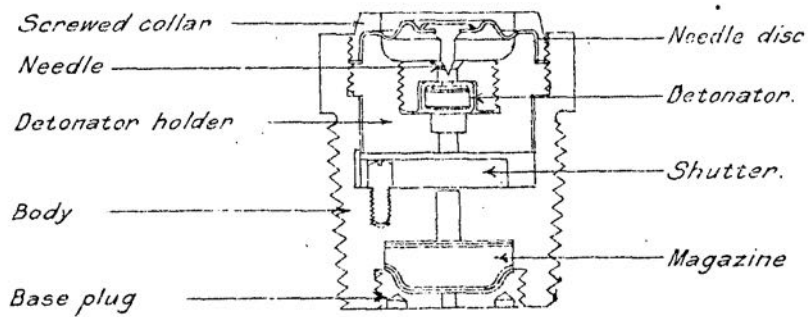
SHELL, B.L., HIGH EXPLOSIVE 9.2-INCH HOWITZER

Scale = $\frac{1}{4}$ "

TYPICAL.

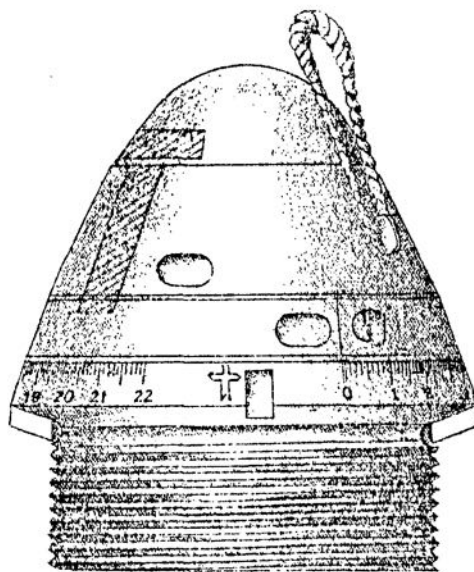
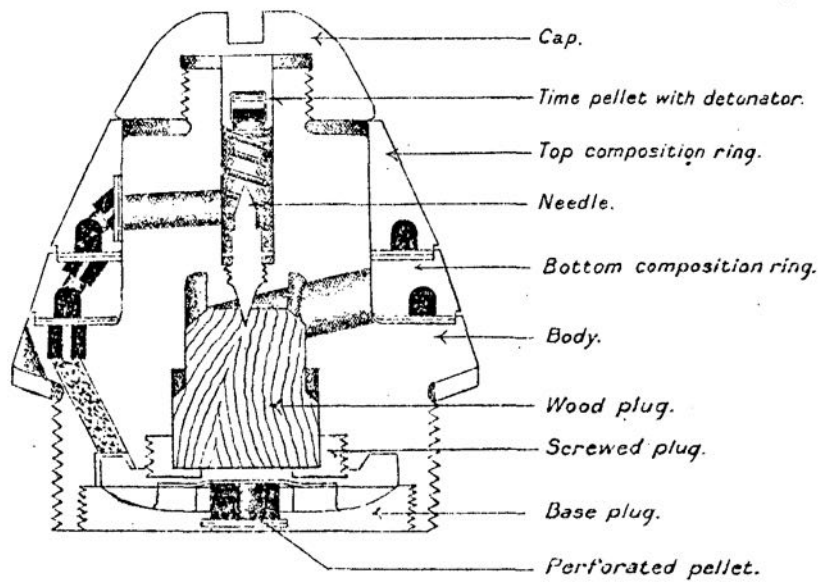


FUZE, PERCUSSION, D. A., WITH CAP, N^o 51.
(TYPICAL)



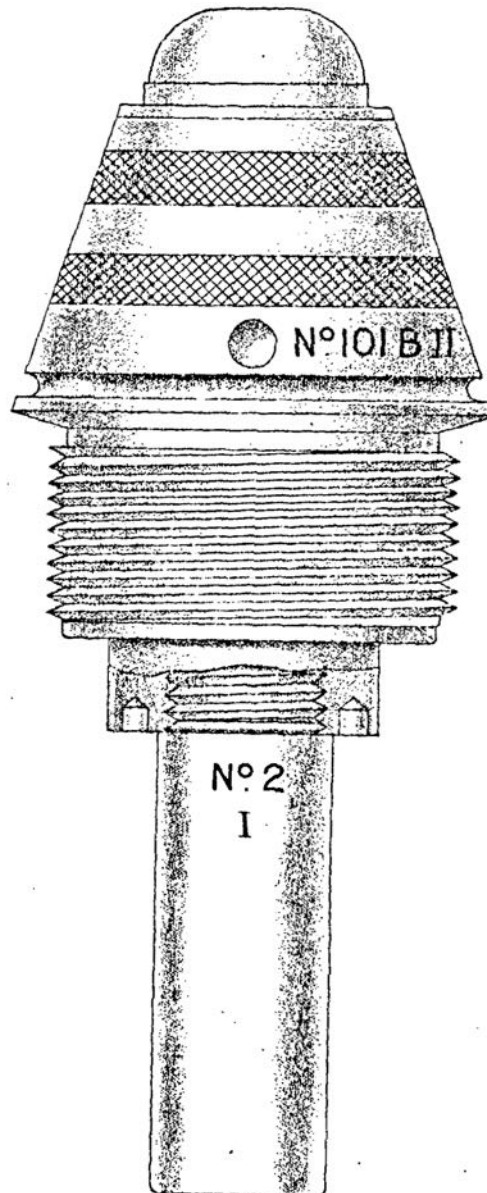
FUZE, TIME, N° 188 M, MARK V.

FULL SIZE.

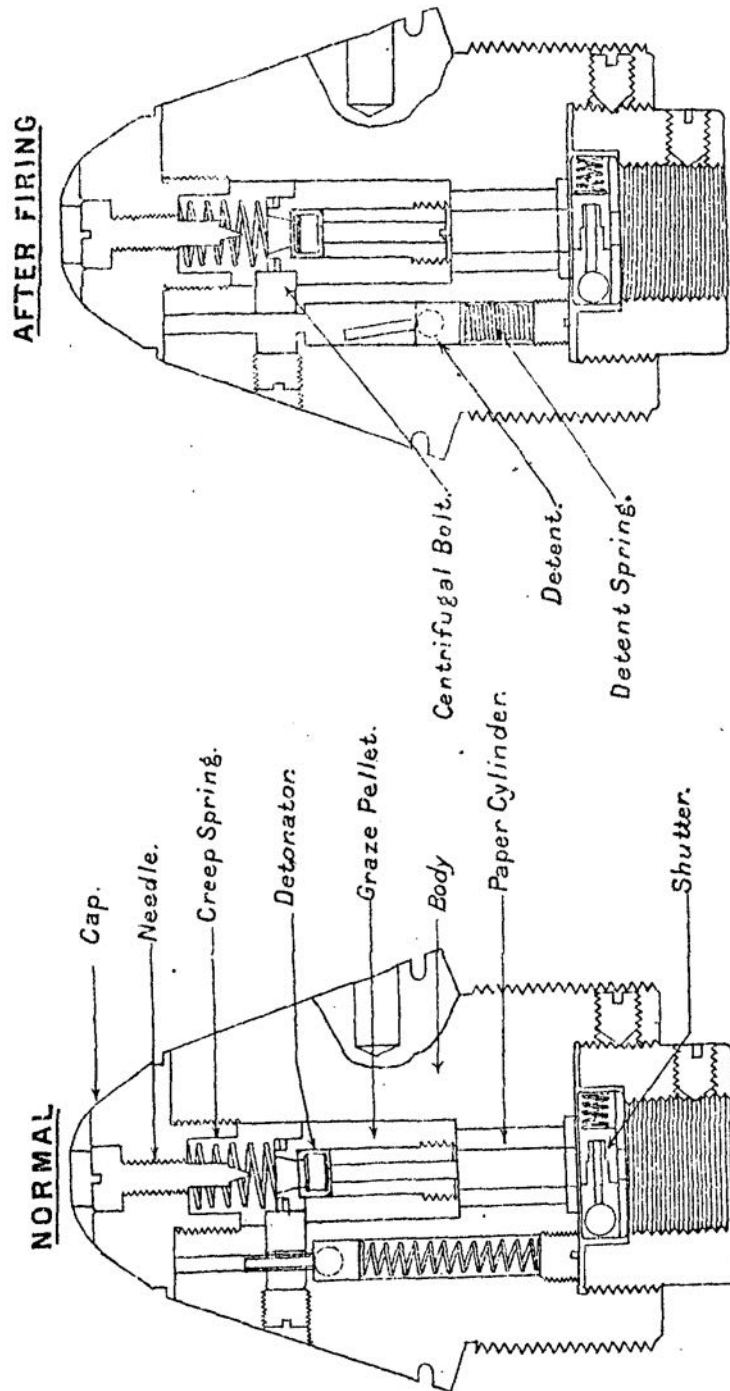


FUZE, PERCUSSION, N° 101 B, MARK II.
WITH GAINÉ N° 2.

SCALE $\frac{1}{1}$.

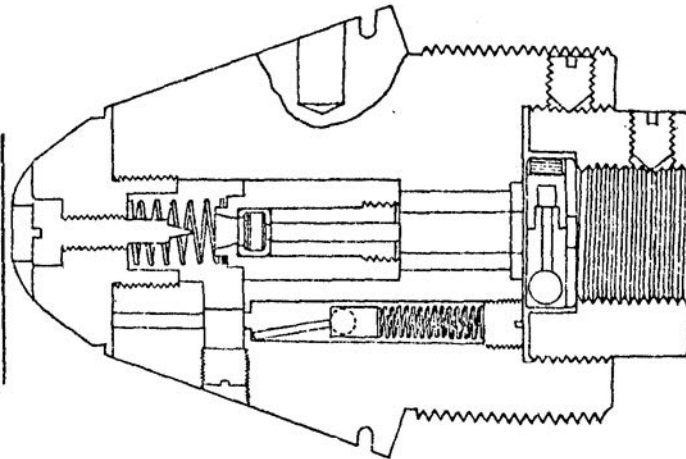


FUZE, PERCUSSION, N° 101B, MARK II.

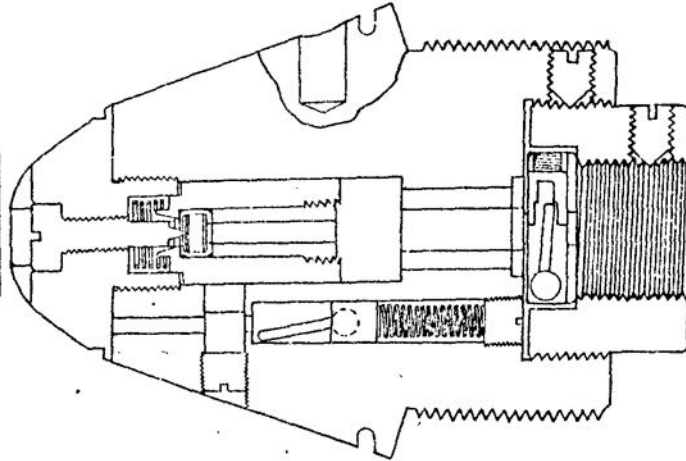


FUZE, PERCUSSION, N° 101B, MARK II.

DURING FLIGHT



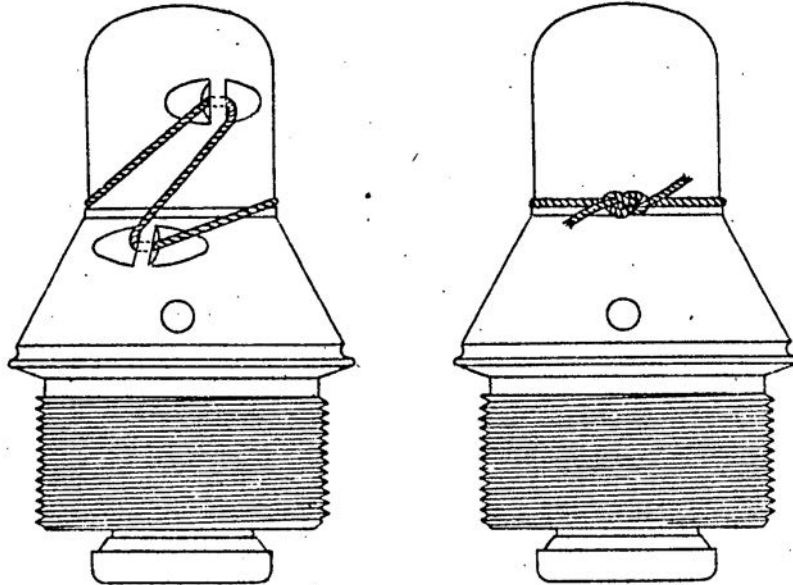
ON GRAZE



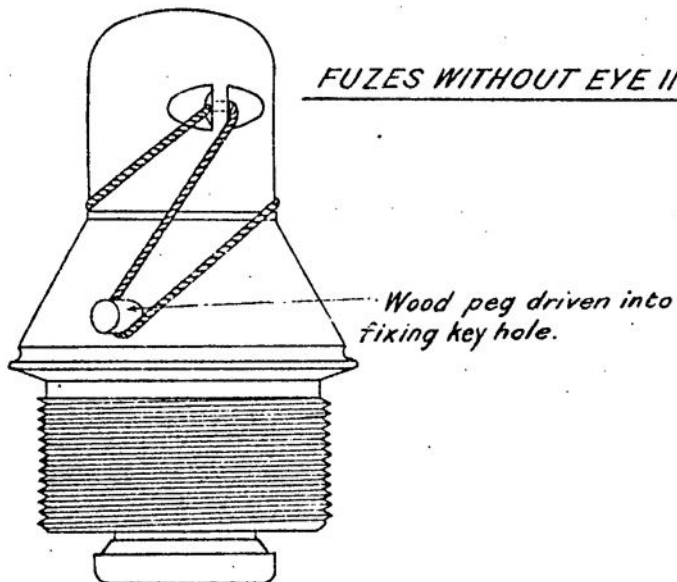
FUZES, PERCUSSION. WITH CAP. N^{os} 106 AND 106^E

METHOD OF SECURING CAP WITH CORD.

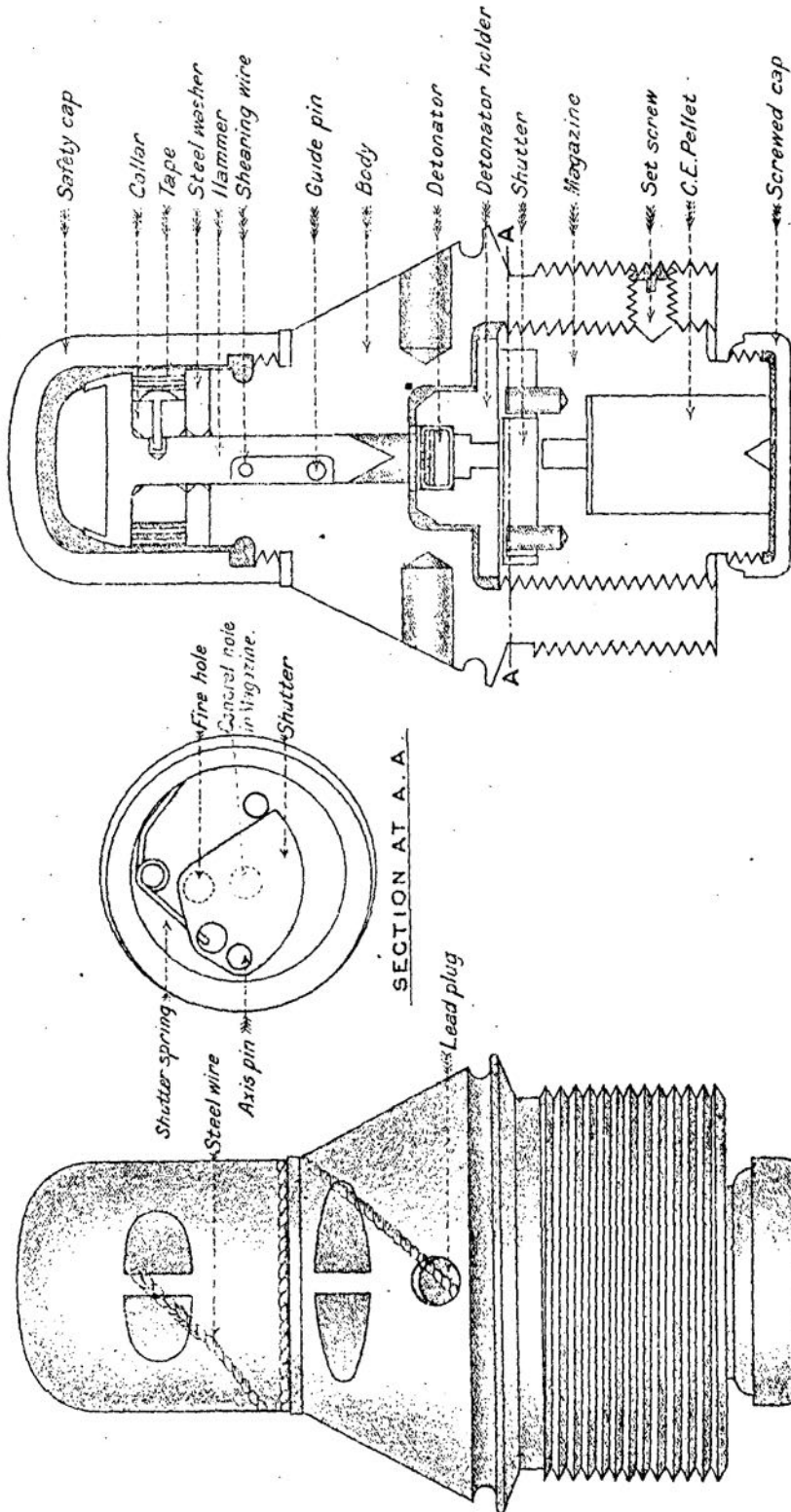
FUZES WITH EYE FORMED IN BODY.



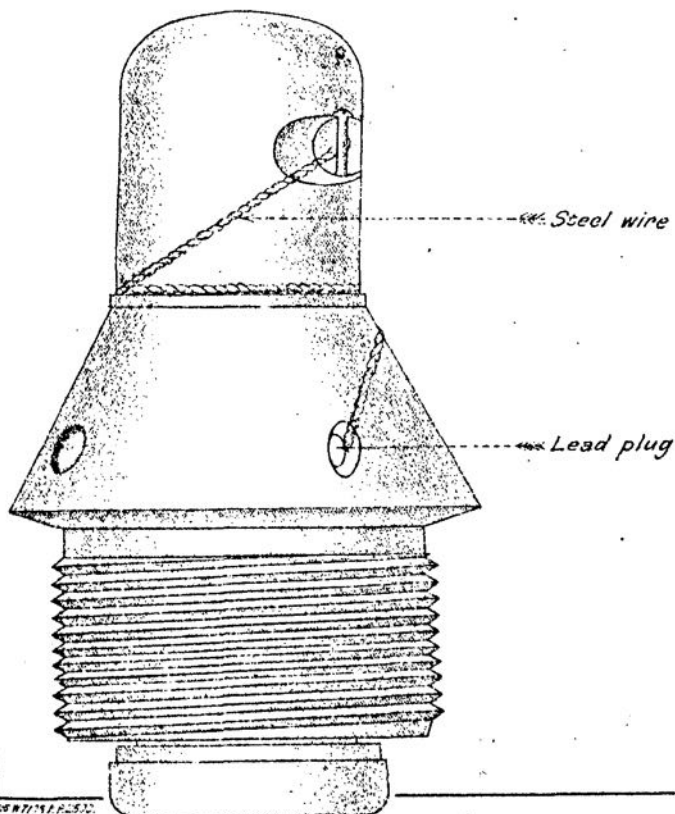
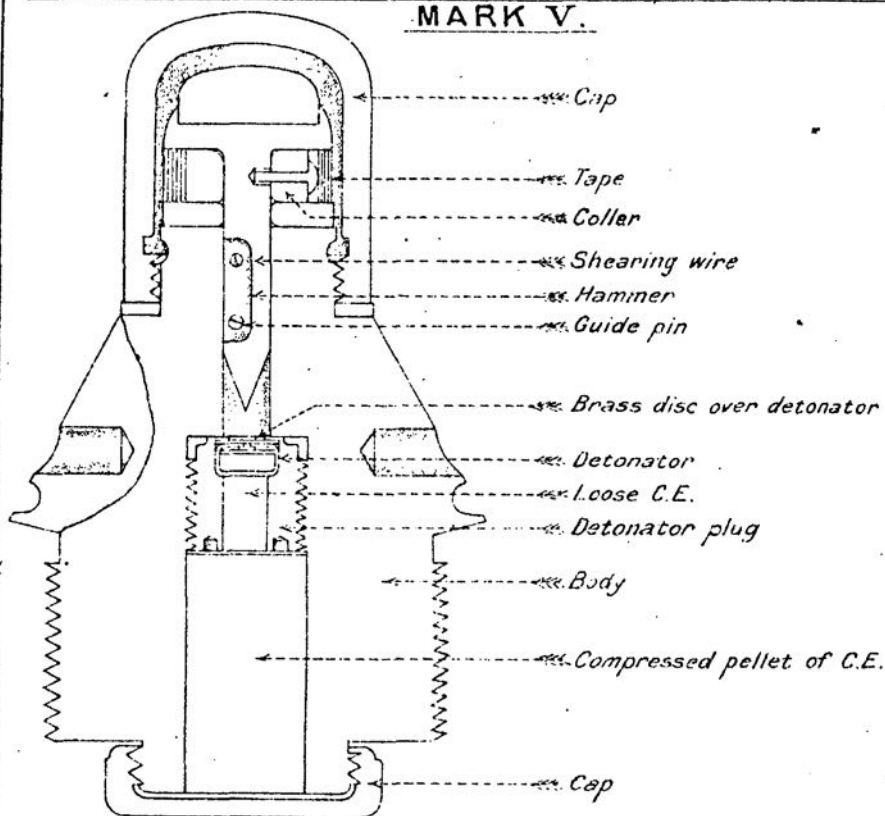
FUZES WITHOUT EYE IN BODY.



FUZE, PERCUSSION, WITH CAP, N° 106 E MARK IV.

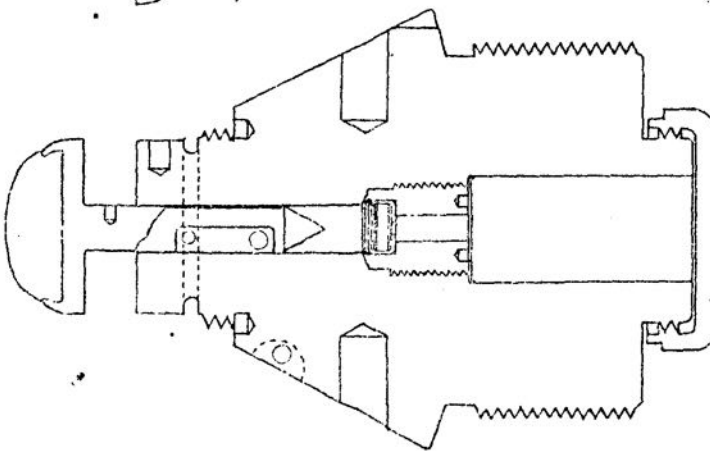


FUZE, PERCUSSION, WITH CAP, N^o 106 MARK V.

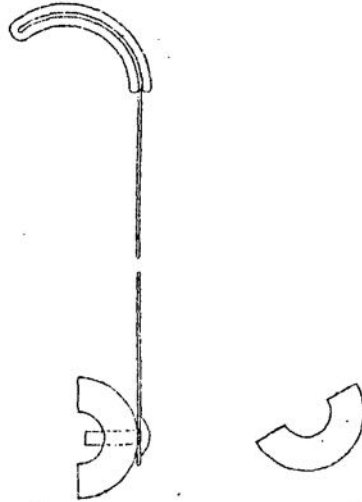
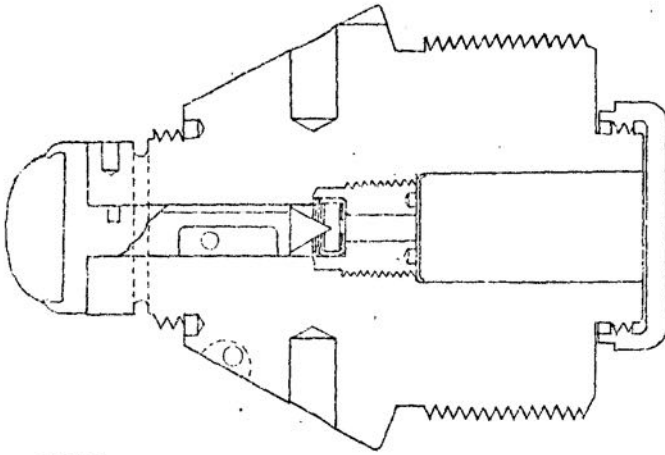


FUZE, PERCUSSION, WITH CAP, N° 106, MARK V.

DURING FLIGHT

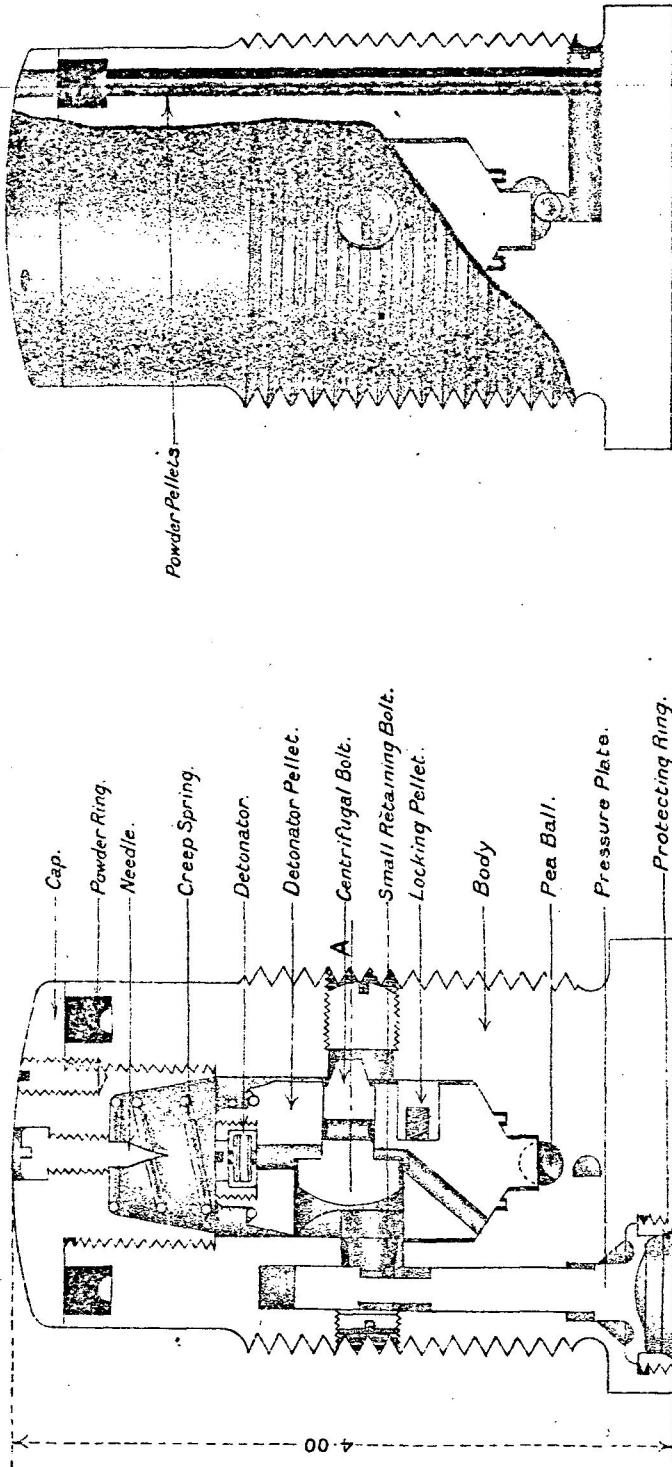


ON GRAZE



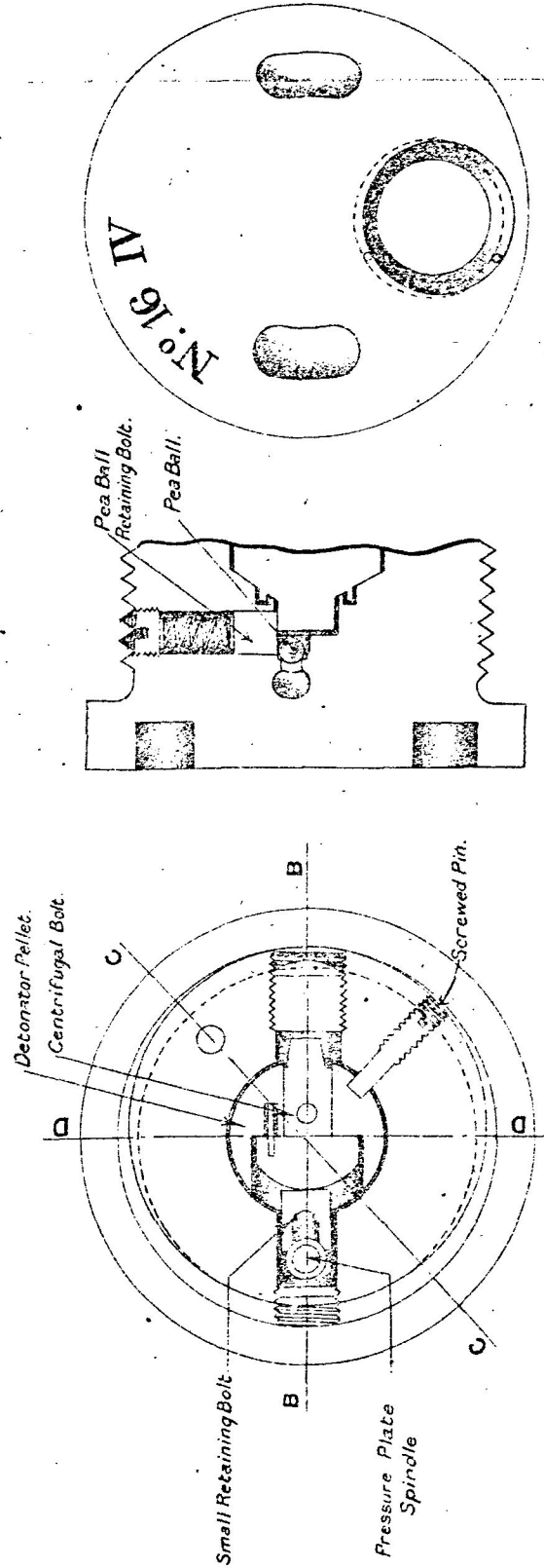
FUZE, PERCUSSION, BASE, LARGE NO. 10. MARK 11.

FULL SIZE.



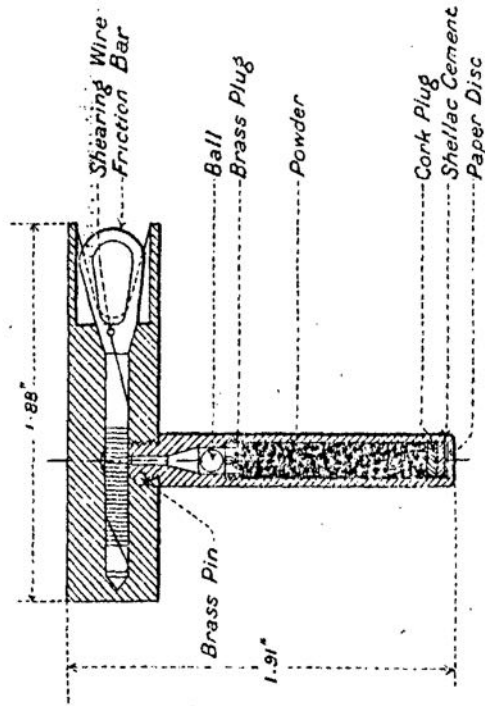
SECTION AT B.B.

PART SECTION AT C.C.

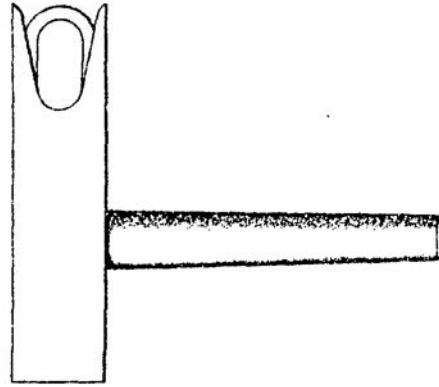


TUBE, FRICTION, "T."

SCALE— $\frac{1}{16}$."



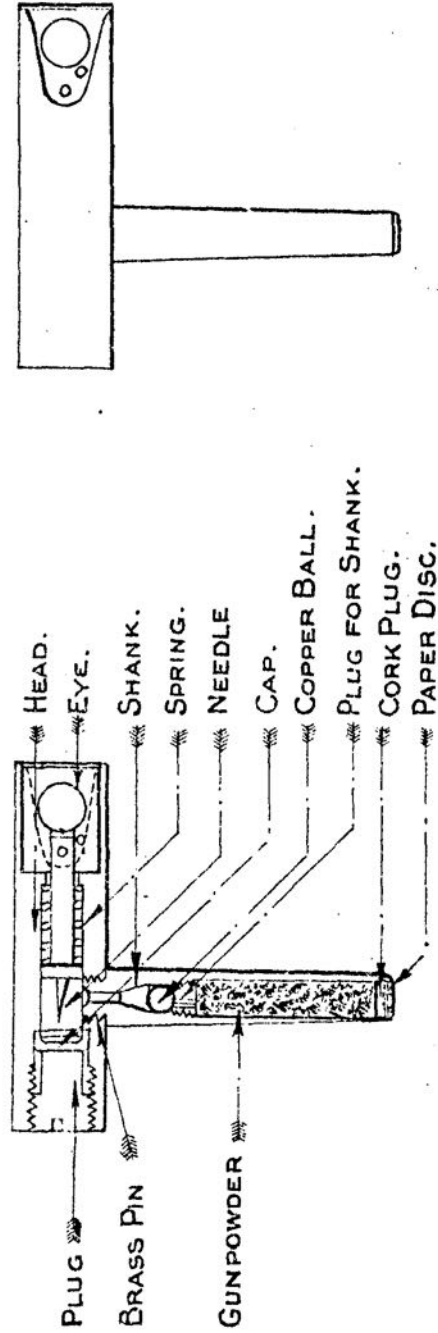
SECTION



ELEVATION

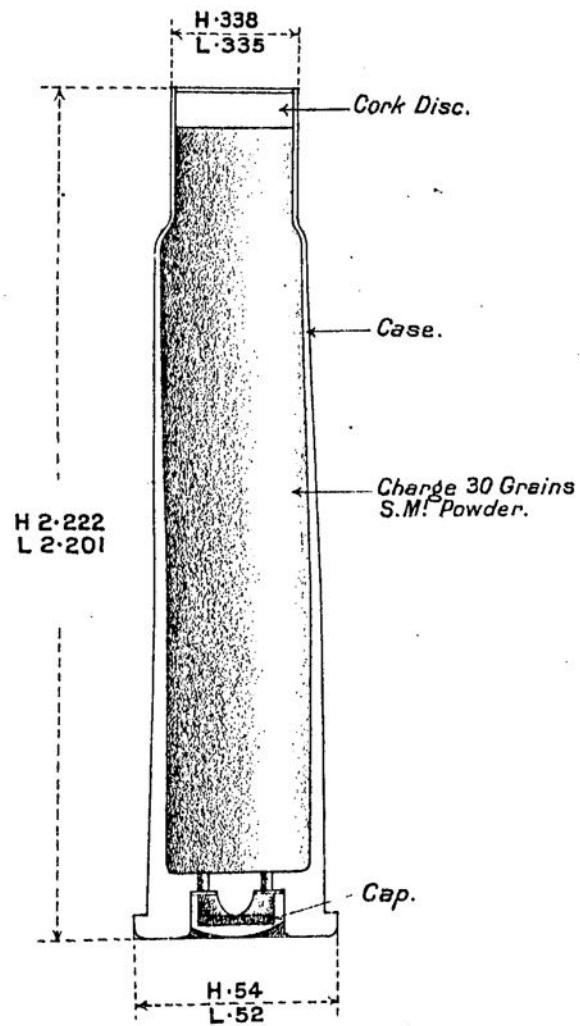
TUBE, PERCUSSION, "T" MARK I.

SCALE 1/1.



TUBE, PERCUSSION, S.A. CARTRIDGE, MARK I.

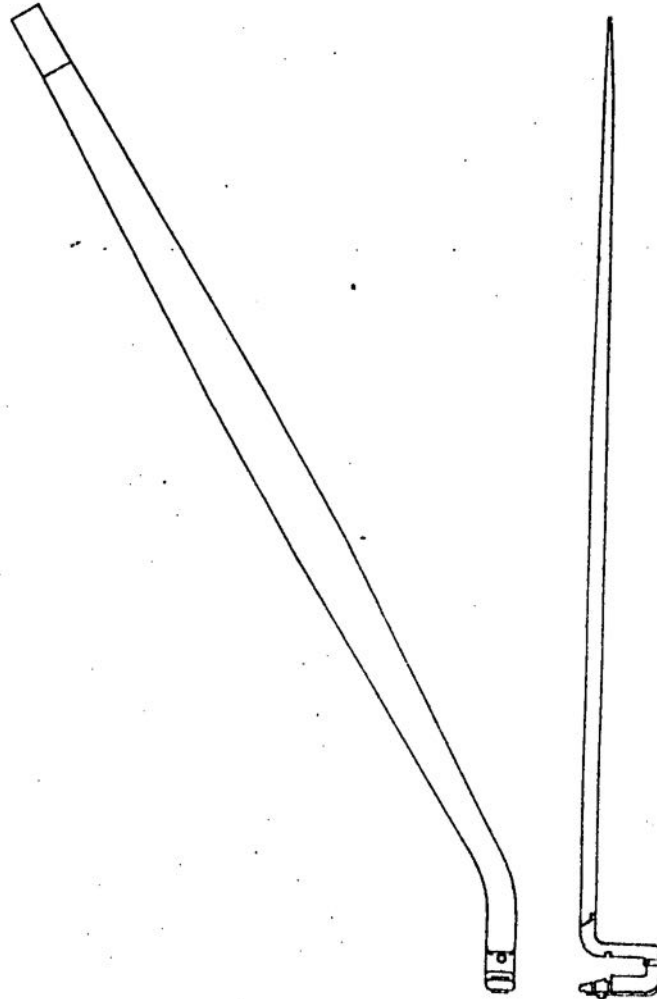
SCALE 2/1.



LEVER, EXTRACTING AND INSERTING "T" TUBE, B.L. 12-INCH MARK II AND 9.2 INCH.

HOWITZERS.

— SCALE = $\frac{1}{8}$. —



ENGINEERING OFFICE